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SOUTH PACIFIC COMMISSION

quarterly BULLETIN

VOL. 4. NO. 4 OCTOBER, 1954

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PUBLISHED BY THE SOUTH PACIFIC COMMISSION, NOUMEA, NEW CALEDONIA

THE SOUTH PACIFIC COMMISSION

The South Pacific Commission is an advisory and consultative body set up by the six Governments responsible for the administration of Island Territories in the South Pacific region. Its purpose is to recommend to the member Governments means for promoting the well-being of the people of these territories. It is concerned with social, economic and health matters. Its headquarters are at Noumea, New Caledonia.

The Commission was established by an Agreement between the Governments of Australia, France, the Netherlands, New Zealand, the United Kingdom and the United States of America, signed at Canberra on the 6th February, 1947, and finally ratified on the 29th July, 1948. Until the 7th November, 1951, the area of the Commission's activities comprised territories lying generally south of the equator from and including Netherlands New Guinea in the west to the French Establishments in Oceania and Pitcairn in the east. On 7th November, 1951, an additional Agreement was signed at Commission headquarters in Noumea on behalf of the six participating Governments, extending the scope of the Commission to include Guam and the Trust Territory of the Pacific Islands under United States administration.

The Commission consists of twelve Commissioners, two from each Government, and from 1948 until 1953 met twice a year. It now normally holds one Session each year. There are two auxiliary bodies, the Research Council and the South Pacific Conference.

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The Research Council, which assembles once a year, held its first meeting in May, 1949. Members are appointed by the Commission, and are selected for their special knowledge of the questions with which the Commission is concerned, and the problems of the territories in these fields. The chief function of the Research Council is to advise the Commission what investigations are necessary. Arrangements to carry out those that are approved are the responsibility of the Secretary-General and other principal officers.

The South Pacific Conference, which meets at intervals not exceeding three years, consists of delegates from the local inhabitants of the territories, who may be accompanied by advisers. The first Conference was held in Suva in April, 1950, and was attended by delegates from fifteen territories and from the Kingdom of Tonga. The second Conference was held at Commission headquarters in April, 1953.

The Commission's staff includes six principal officers, as follows: Secretary-General, Sir Brian Freeston, K.C.M.G., O.B.E.; Deputy Chairman of the Research Council, Dr. E. M. Ojala; Deputy Secretary-General, Mr. John Ryan; Executive Officer for Health, Dr. E. Massal; Executive Officer for Economic Development, Dr. A. H. J. Kroon; Executive Officer for Social Development, Mr. H. E. Maude, O.B.E. The Deputy Chairman and the three Executive Officers are ex officio members of the Research Council. The principal officers are supported by a small technical and administrative staff.

Further particulars of the Commission's activities may be obtained from the Secretary-General, Noumea, New Caledonia.

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THE SPC QUARTERLY BULLETIN, first published in January, 1951, features articles on selected activities in the Commission's three main fields of operation: economic development, health and social development. Articles are also contributed by specialists working in these and related fields, in the territories within the Commission area.

THE BULLETIN is given selective world distribution to people and institutions in widely differing fields sharing a common interest in the purposes and work of the Commission. It is published in two editions, English and French.

SUBSCRIPTIONS and orders for single copies should be directed to: South Pacific Commission, Box 5254, G.P.O., Sydney, Australia.

ALL OTHER ENQUIRIES relating to the SPC QUARTERLY BULLETIN should be directed to: The Editor, South Pacific Commission, Box 5254 G.P.O., Sydney, Australia.

SUBSCRIPTION RATES are as follow: One year, subscription 8/- sterling, or $1.15, by surface mail; three years, subscription 20/- sterling, or $2.80, by surface mail. Rates for postage by airmail will be supplied on application.

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Rice Growing In New South Wales

By W. POGGENDORFF

Chief, Division of Plant Industry, New South Wales Department of Agriculture.

A fine crop of paddy rice approaching maturity at Yanco, in the Murrumbidgee Irrigation Area of south-west New South Wales.

RICE has been grown on a commercial scale in New South Wales since the 1924-25 season, when 157 acres were put under crop on the Murrumbidgee Irrigation Area as a result of experimental work with lowland varieties carried out by the Department of Agriculture in co-operation with the Water Conservation and Irrigation Commission, since the 1922-23 season. Many previous attempts to produce rice were unsuccessful because of varieties not suited to local conditions.

All rice grown in New South Wales is of the "flooded" type, on one or other of the Irrigation Areas.

From 157 acres, which produced 98 tons of paddy in 1924-25, the annual rice acreage in New South Wales has steadily risen to 34,000 acres, which produced 74,000 tons in 1952-53 (i.e. 2.18 tons per acre).

New South Wales is usually among the three highest yielders per acre in the world, the other two being Spain and Italy. The average yield per acre has risen steadily since 1924-25, except when pure seed production had to be abandoned by the Department during the War; the increase is due to both better selected seed and to improved farming practices, particularly the increasing use of pastures in wide rotation.

AVERAGE PADDY YIELDS PER ACRE OVER 5-YEAR PERIODS

1924-25 to 1928-29	1.40 tons per acre
1929-30 to 1933-34	1.56 " " "
1934-35 to 1938-39	1.83 " " "
1939-40 to 1943-44	1.67 " " "
1944-45 to 1948-49	1.76 " " "
1949-50 to 1953-54	2.09 " " "

(A bushel of rice weighs 43 lb.)

Rice has been grown on the poorest as well as the best classes of land, and has given excellent results. Throughout the Murrumbidgee Irrigation Area there is a considerable amount of shallow, medium to heavy clay overlying a stiff clay sub-surface and subsoil which, prior to being utilized for growing rice, had proved unsuitable for the purpose of growing other crops. Rice leaves the land more friable and is now the means of utilizing profitably much of the once unwanted land on the Area.

Rice-growing has also been instrumental in promoting pasture development and fat-lamb raising throughout the irrigation scheme. Rotational cropping is essential to successful rice-growing, and most of the farmers possess sufficient rice land to follow a three or four-year rotation, and in some instances a six or seven-year crop rotation. Consequently, to add to the grazing capacity of the farms, temporary pastures, chiefly Wimmera ryegrass and Subterranean Clover, are very widely used.

All rice produced is vested in a grower-controlled Rice Marketing Board, which pays growers £37 per ton at present for rice delivered, and subsequently sells it to millers, principally the Rice Growers' Co-operative Mill.

The estimated loss in dressing rice is from 16 to 20 per cent of the weight of the rice; the proportion of cleaned and polished commercial rice to paddy ranges from one-half to two-thirds. The approximate milling out-turn per 100 lb. of paddy is:—

60.5 lb.	commercial rice
3.7 lb.	polish
17.3 lb.	bran
18.5 lb.	hulls

Whole kernels are the most valuable product of the rice milling process, and are used almost entirely for human consumption. They are sold either whole, or in the form of proprietary breakfast foods, such as rice bubbles, puffed rice, rice flakes, etc.

Broken grain is used principally for the manufacture of starch, rice meal, rice flour, moulding flour, and face powder.

Rice polish has the appearance of flour, but partakes of the qualities of both pollard and rice flour, having great value as a concentrate.

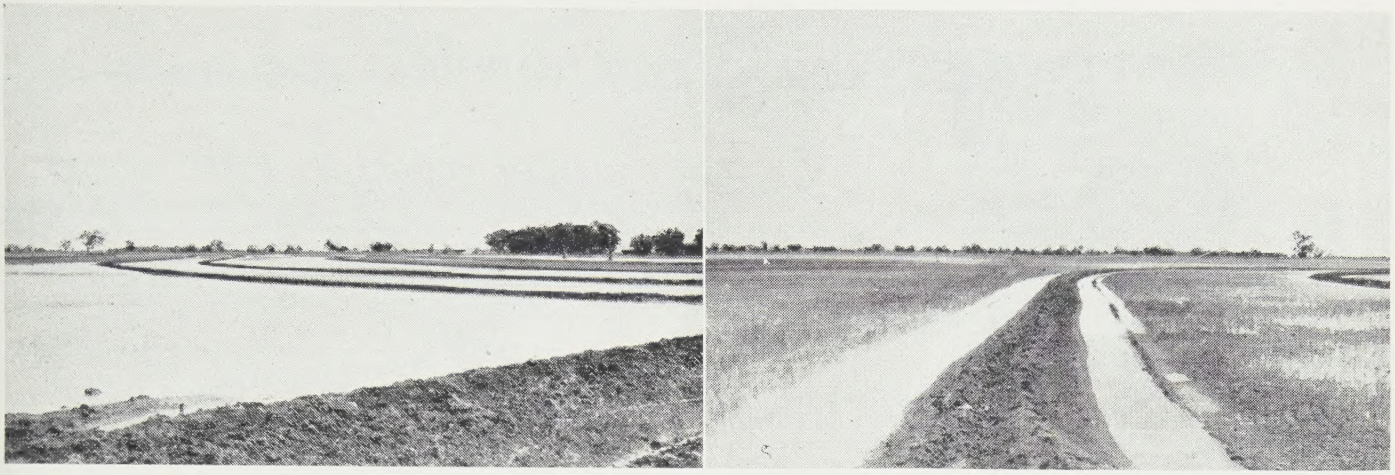
Rice bran and pollard are a valuable source of Vitamin B, possessing a high percentage of protein and most of the mineral constituents of the grain. They are valuable for stock fodder, but owing to their high oil content are apt to become rancid quickly, as is the case with brown rice.

Rice straw is extremely tough, and in addition to being used for packing, is a valuable paper making material (not "rice paper," however, which has no connection with rice).

Cultural Requirements

Successful rice culture in Australia is dependent upon—

1. Sufficiently high temperatures during the growing period (lat. 35°S).
2. Freedom from extreme hot to cold changes.



Left: Young rice being watered. Note layout of bays on contours. Right: Young rice being drained following one of several waterings prior to permanent flooding.

Recent surveys have shown that rice cultivation offers promising possibilities in several South Pacific territories. This article by a noted authority on rice, Mr. W. Poggendorff, describes the highly successful development of the industry in New South Wales. It contains much of interest and practical value to planters (who should however bear in mind that the climate, soils and water supplies differ from those in the tropical South Pacific).

3. A dependable water supply during the growing period.
4. Soils that are comparatively flat or level and overlying an impervious subsoil.
5. Satisfactory surface drainage.
6. Control of water weeds.
7. Maintenance of soil fertility.

As rice is grown on land that is submerged under 6 to 12 inches of water to obtain best results, the soil must be capable of retaining the water on the surface; otherwise rice-growing becomes uneconomic. The quantity of water required to cover and maintain a depth of at least 6 inches over a large area of country, taking into consideration losses by seepage, evaporation, and transpiration by the plants, is between 5½ and 6½ feet per acre.

It is usual to plough during the winter and follow with cultivation, which may be carried out with disc or springtooth implements, to destroy weeds as well as to reduce the land to a good tilth.

Grading and Check Banking

If the land is uneven, it must be graded to allow of even watering, which is vital in obtaining a uniform and quick germination of rice seed, in addition to producing a uniform and heavy yielding crop.

Large, suitably-constructed check banks are required to retain the water on the land. The direction of these banks and their number are determined by the contour of the land and their solidity is dependent upon their width and height, as well as the length of time they have been constructed prior to sowing the crop.

The fall between the check banks is usually about 3 inches.

The size of the bays is largely governed by the contour of the land; on the majority of farms the most convenient and easily controlled size is found to be from 4 to 6 acres, though in some cases bays can be made much larger with advantage. It is a big disadvantage to have long bays running in the same direction as the prevailing winds.

The height and width of the check banks should be such as will successfully hold the water on the bays to the required depth. As it is usual to submerge the land to a depth of 6 inches to a foot, the banks should be at least 18 inches to 2 feet high when first erected, as they usually sink in varying degrees, according to the type of land, when the water is put on. During recent years it has been found advisable to make them 12 to 14 feet at the base, according to the type of soil.

To make the check banks, parallel furrows are struck out some distance apart (usually 7 to 9 feet, according to the size of bank required), the land between these furrows being left untouched, thus leaving a solid foundation. The loose soil from the ploughing is then pushed in with a delver.

The process of alternately ploughing either wider or deeper, to provide banking material, and delving is continued, the bank gradually being erected by merely pushing the earth towards the centre, thus building the bank from the outside until the centre is filled and the bank topped. A heavy single furrow mouldboard plough or a road plough is required to do this work, on account of the heavy clay and the depth it is necessary to plough to obtain sufficient soil to add height to the banks.

Varieties

The Department has been conducting a comprehensive programme of introduction and testing of varieties of rice obtained from all accessible rice-producing centres throughout the world since 1928.

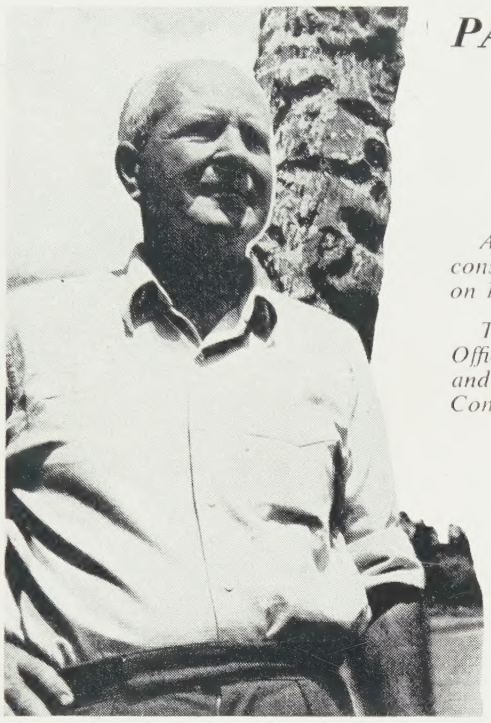
In addition to these, many hundreds of field selections have been made from commercial crops throughout the area, which have been subjected to critical observations, further selection, and yield testing over a period of years in stud plots.

The only variety of rice now grown commercially in New South Wales is a strain of Caloro continually produced as pure seed by the Department of Agriculture and the Rice Marketing Board in co-operation.

It was customary at one time to use 2 cwt. per acre of sulphate of ammonia with rice, but the development of rotation with clover pastures has eliminated the need. The pastures are top-dressed with 1 cwt. superphosphate per acre annually.

The Weed Problem

The most serious problem that the rice grower has to contend with is weed growth, for the soil and climatic conditions of the area are very favourable to excessive weed growth, principally



Mr. R. Watson, FAO Rice Improvement Officer.

PACIFIC RICE SURVEY . . . Commission to consider report by FAO expert

A report on rice-growing possibilities of Pacific Island territories will be considered by the Commission at its Thirteenth Session opening at Nouméa on 11th October.

The report was prepared by Mr. R. Watson, FAO Rice Improvement Officer with many years' experience in rice production and marketing in Burma and East Africa. His services were obtained by agreement between the Commission and the Food and Agriculture Organization.

Mr. Watson began his four months' survey last December in New Caledonia, and later visited Fiji, Papua and New Guinea, British Solomon Islands Protectorate, Netherlands New Guinea and the New Hebrides. In each territory he studied rice production and potential rice-growing areas with a view to recommending action for stepping-up production.

Rice is becoming more popular in the region as a staple item of diet, and the Commission arranged this survey because it felt that there were good prospects for an expansion of rice production within the area.

It is hoped it will be possible to publish Mr. Watson's main findings in a later issue of the "Quarterly Bulletin."

cumbungi (*Typha spp.*), water or barnyard grasses (*Echinochloa crus-galli* and *Panicum colonum*).

Adequate and timely cultivation and a suitable rotation of crops are the best means of weed control; a "drowning" method is often used for barnyard grass germinating with the rice.

Over a period of years excellent results have also been obtained in the control of barnyard grass by draining the water from the rice fields when the weather has become warm, and very heavily stocking with sheep to eat off all plant growth as quickly as possible (usually seven to ten days) and immediately filling the bays again to full capacity. While this treatment definitely delays the maturity of the rice and is not always recommended, it otherwise affects the rice plants very little if carried out quickly, while most of the barnyard grass fails to grow through any depth of water and soon dies.

The raising of sheep, principally suitable crossbreds, for the fat-lamb market, has become a highly profitable mixed farming proposition in conjunction with rice growing during the last fifteen years. Sheep also provide a means of keeping weed growth under control. A certain amount of grain will always be lost on the ground at harvesting, and this can be turned to profit by running pigs or turkeys on the stubble.

Sowing and Irrigation

The method generally adopted is to sow the seed at a shallow depth as if it were wheat or oats, the ordinary wheat drill or combine being used, and the seed being covered by the soil in the usual way. A uniform depth of seeding is most desirable, for uneven depths of sowing often produce uneven germinations and subsequently uneven flowering and maturity of crops.

Grading of rice seed prior to sowing is universally practised.

Immediately after seeding the land is irrigated to obtain a germination, and this is usually followed, in about a week to a fortnight, with a second application of water.

On clean land where weed control is not a first consideration, the young plants are then irrigated in the usual way as often as required to keep the land in a moist state until they are about 6 inches high (usually about thirty days after emerging), when the water should be allowed to remain on the crop, leaving the tips above water. The depth of submergence is then gradually increased with the growth of the plants until the full depth of water covers the whole rice field, the depth being governed by the strength of the check bank system, and ranging to anything up to 15 inches.

To obtain the heaviest yields and best quality rice, it is necessary to keep the water on the crop until the last few grains towards the base of the heads are out of the milk stage and in the full dough stage, and the panicles are well turned down. When the crop has reached this stage the usual procedure is to stop all water from entering the rice bays, and to allow the crop to reach maturity while the whole or part of the water, as the case may be, is evaporating. Should the paddy have matured before the whole of the water has got away, the remaining water is drained off.

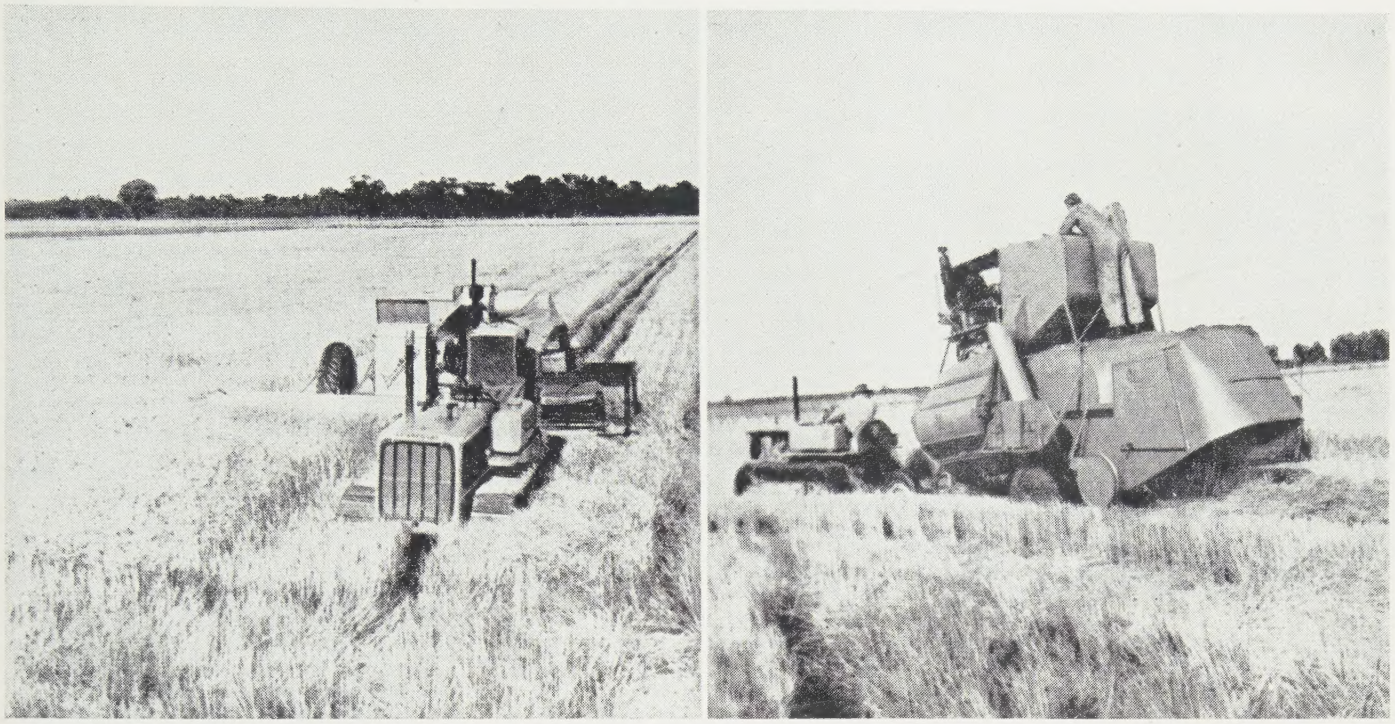
In draining off the water, care must be taken not to carry out the operation too quickly, but to extend it over a few days at least; otherwise heavy crops are likely to lodge, and harvesting difficulties in addition to loss of paddy result.

Harvesting

Usually the crops are harvested during the months of April, May and June. Engine functioned tractor or horse-drawn headers are used, equipped with pneumatic tyres. A few crawler mounted, self-propelled, fore-cut headers are also in use, particularly for the first cut around each bay.

Headers have 8 feet to 12 feet cuts, and cut, thresh, winnow and clean the paddy in the one operation; they are fitted with large grain boxes and bagging platforms that enable the grain to be bagged while the machine is on the move.

Harvesting operations cannot be carried out while the grain is wet, or during foggy weather. The bagging of wet rice



Left: Harvesting paddy with a rice header. Note bagging platform at side. Right: Another type of rice header with large grain bin which is emptied periodically into trucks for bulk handling.

must be avoided, as it cannot be delivered to the storage sheds with a greater moisture content than 16 per cent; further, rice is subject to mould, and is then naturally objected to by both the Rice Marketing Board and the millers.

Increasing interest is being taken in artificial drying, rice mills having installed the necessary equipment. It is a means of both drying wet rice and improving milling quality.

Diseases and Pests

Rice is fortunately free from disease in New South Wales, and stringent quarantine precautions are enforced to keep it so.

A few insect pests are not seriously troublesome, but wild ducks occasionally do considerable damage, particularly in dry years when they concentrate on the irrigation areas.

Sun or Weather Cracking

During most seasons in practically all rice crops, a surprisingly high percentage of grains show a fine crack (crosswise), but only with unsuitable conditions does the grain actually break, either during stripping or milling operations. This is termed sun or weather cracking, the chief cause being rapid fluctuation of atmospheric humidity during ripening.

Crops should be harvested as soon as they are ripe to avoid this trouble. Deliberate harvesting when the grain still contains about 25 per cent moisture and controlled artificial drying to at least 16 percent is a sure means of avoiding cracking and greatly improving return of whole grain on milling.

Storing and Consigning

Every individual rice grower is allotted a number, which, in addition to the letters "R.M.B.," must be stencilled on every corn sack of paddy delivered to the Rice Marketing Board. On being carted to the receiving centres for storage, every bag is tested by a representative of the Board, and must fulfil all requirements in relation to such matters as moisture content, cracked grain, green grain, freedom from weed seeds and other objectionable features. Consignments to millers, either ex-field or from storage sheds, are tested by a miller's representative.

Rice and Cattle-Raising Project for Netherlands New Guinea

PROJECTS proposed by the Advisory Committee for Agricultural Development in Netherlands New Guinea, which visited that territory in July-August, 1953, include a rice and cattle-raising project in Merauke, with the initial objective of making Netherlands New Guinea self-supporting in rice and meat.

It is proposed to start with the construction of an experimental farm of 500 acres in the Koembe River district near Merauke for the mechanical cultivation of irrigated rice. If the results are successful, the area under cultivation will be progressively increased up to 30,000 acres, which should be sufficient to cover the total internal rice consumption of the territory for some years. The cultivation of rice will be combined with cattle raising on an extensive basis and, if possible, with the rotational cultivation of other crops, such as soya beans, ground nuts, and cotton.

In addition to this mechanical cultivation of irrigated rice, much attention is being paid by the agricultural extension service to native rice cultivation, especially in the Merauke District.

Native Rice Production in Papua and New Guinea

The encouragement of native village rice production in the Madang and Sepik Districts of Papua and New Guinea, partly to give the villages an additional source of food and income, and partly to advance their agricultural and economic education, is progressing.

More than 300 villages, comprising about 25,000 natives, were brought under the project in 1953, and it is planned to include an additional 112 villages this year. These natives produced about 450 tons of milled rice in 1953.

Estimated production for 1954 is 815 tons, and a target for 4,200 tons from the villages in the Madang and Sepik Districts has been set. In 1951 the total production in the same area was less than 10 tons.

Above: The experimental tuna fishing boat "Hollandia" which operates out of Manokwari, on the north coast. Right: The North Sea type trawler "De Goede Hoop", operating from Sorong, is taking an average catch of three-quarters of a ton of fish per day.

Fisheries Investigations In Netherlands New Guinea

*From the Government of Netherlands New Guinea comes further information on the steps being taken to stimulate the development of the marine resources of that territory.**

UNDER Mr. D. C. Zwollo, the Sea Fisheries Branch of the Department of Agriculture and Fisheries has five boats engaged in experimental fishing operations.

Operating daily from Hollandia, two launches with Papuan crews are trolling, trawling or beach seining in the Humboldt Bay area up to the Australian New Guinea border, with satisfactory results. The fish are sold at ship's side and the demand exceeds the supply. Long range plans are being made for the development of Papuan fishing co-operatives to exploit this fishery.

One North Sea type trawler with accommodation converted to tropical conditions, manned by Dutch officers and Papuan crew, is operating from Sorong. This trawl cutter and troller *De Goede Hoop* is of riveted steel construction 21.9 metres (72 feet) long, 5.63 metres (18½ feet) beam, with a draft of 2.50 metres (8 feet 2½ inches). Driven by a direct-coupled Kromhout 150 h.p. two-stroke Diesel engine, it is capable of 8½ knots at 430 r.p.m. Equipment consists of a two-way radio, echo-graph and cathode-ray fish-finding device of latest design, a mechanical refrigeration system for the fish-hold, with fuel and water capacity for fishing trips up to twelve days' duration.

Some good results have been obtained in experimental trawling on a shoal area on the north coast, the catch averaging ¾ ton per day of a quality better than was expected. The catches are landed at Hollandia, Manokwari or Sorong, where they are sold from the ships' freezers in the absence of adequate shore facilities for cold storage. With the aid of the modern electronic fish location gear on board, a considerable amount of survey work and experimentation in trawling techniques is taking place.

The experimental tuna fishing boat *Hollandia* is operating from Manokwari on the north coast, in the waters north of New Guinea. This steel-riveted combined live-bait and long-liner with trolling poles is 25 metres (82 feet) long and 5.50 metres (18 feet) beam, with a draft of 2.60 metres (8 feet 6½ inches). The main engine is a direct-coupled Kromhout 200 h.p. two-stroke diesel giving a speed of 10 knots at 430 r.p.m. Equipped with a two-way radio, mechanical refrigeration for the fish-hold, and a long-line hauler driven by the main engine, it has fuel and drinking water capacity for trips of up to fourteen days.

At the same time, the third launch is also operating out of Manokwari, investigating concentrations of bait fish suitable for use in tuna fishing.

* An earlier article appeared in the **Quarterly Bulletin** for October, 1953.—Editor.

How to Make Filmstrips

A practical manual on the production of filmstrips is now available from the Executive Officer for Social Development, Box 5254, G.P.O., Sydney, price 2/6d. stg. It was prepared by the Commission's Visual Aids Officer, Mrs. N. E. Phelan, for the guidance of amateur photographers in Pacific territories who are interested in making their own filmstrips for educational purposes.

The booklet, which is illustrated, covers such topics as preparatory work, planning and taking photographs, editing and the preparation of commentaries.

Eye Health In The Trust Territory

By C. E. SAYERS

*Results of a survey on eye health in the United States Trust Territory of the Pacific Islands are incorporated in a report by Dr. Howard E. Crawford, of Hilo, Hawaii, a well-known ophthalmologist and a former chairman of the Hawaiian Medical Society.**

Mrs. Hamman, a member of the survey team, giving a talk in the Marshalls.

THE survey was made in the three main centres of Truk, Ponape and Majuro between 3rd July and 7th August, 1953. Short visits were also made to several smaller islands in the Eastern Carolines and Marshall Group.

An interesting feature of this important field survey is that much of the practical work, before and during the survey, was done by a Marshallese medical practitioner, Isaac Lanwi, who was given a year's training at Hilo under Dr. Crawford, after which he was established as a full-time medical practitioner in eye medical care.

Historically the survey goes back to 1947 when Miss Eleanor Wilson, a missionary of the Marshall Islands, attended a graduate course in eye health given at the University of Hawaii summer session under the direction of the Bureau of Sight Conservation and Work with the Blind.

On her return to the Marshalls, Miss Wilson tested the visual acuity of a few adults who needed glasses for reading, weaving and other close work. In the next two years, the work increased, and the desirability was discussed of an opthalmological survey of the native population in the Marshalls, Eastern and Western Carolines and the Palau Group.

Nothing came of the project until October, 1951, when Dr. Crawford and Mrs. Grace G. Hamman, Director of the Bureau of Sight Conservation, Territory of Hawaii, were approached, and a plan of procedure drawn up.

The plan involved the specific training in ophthalmology of medical practioners under Dr. Crawford, in particular in refractions and minor surgical procedures.

Two were trained. The first was Dr. Juan Dela Cruz, a Saipanese, and a graduate of the U.S. Naval Hospital Guam Medical Training School. At the end of six months he was re-employed by the U.S. Navy at Saipan. The second was Dr. Isaac Lanwi, who, after a year's training, was felt to be proficient enough to do refractions and major and minor eye surgery.

It was recommended that observations of his work in the Trust Territory should be made by Dr. Crawford; the observation to include major and minor surgery and general diagnostic work.

The survey associated with this observation embraced a survey of visual acuity of a portion of the population and development of a community consciousness of problems of eye health; diagnostic and surgical eye clinics; analysis of ocular defects and recommendations.

The survey team was in addition to Dr. Crawford, Mrs. Hamman and Dr. Lanwi.

The first part of the plan was carried out by Mrs. Hamman and Dr. Lanwi. Difficult eye cases and persons with apparently healthy eyes were examined, and decision made as to selecting a limited number of persons with serious eye defects to attend diagnostic surgical eye clinics which were later attended by Dr. Crawford.

The team felt that the inhabitants of each district were very anxious for eye medical care. Often a mother or father would return with older members of the family without normal vision, or with children just to be sure they had healthy eyes.

To interest the community in an awareness of eye health, a flannel-graph play with localized eye health problems, as well as posters in the various local languages, was used. The flannel-graph was a successful interest-getting technique, and attracted several hundreds to where vision testing was being carried out, knowing that the testing would be interspersed with the play.

Reporting on ocular defects, Dr. Crawford says that the most interesting, indeed startling, condition found on Truk and the adjacent islands was choroidal degeneration. Its incidence was quite high, and had not so far been adequately described.

Dr. A. Leber, a German ophthalmologist, had described a similar condition in Samoa in 1914, but called it a retinosis. He had attributed the disease to *Filaria Bancrofti*.

A survey by Lt.-Commander Allan C. Pipkin of the USNR of filariasis in the Trust Territory (1952) showed that its incidence was highest in the Palau and Truk Districts, and faded away to practically none in the Marshalls. That paralleled almost exactly the incidence of degenerative choroiditis found by Dr. Crawford and his team in the Truk, Ponape and Marshalls Districts; so it would appear there was a relationship.

Dr. Crawford reports that the condition is definitely an involvement of the choroidal and not the retinal layer of the eye. No filaria were seen in any of the cases examined. Fifty-nine cases were diagnosed at Truk, and there must be many more.

Dr. Crawford adds: "The condition is extremely serious from a social and economic point of view. If this eye disease is actually due to filariasis, then the disease filariasis takes on a more serious aspect in the Trust Territory than heretofore suspected, and preventive and theropeutic measures become more urgent. The condition is fully as important as elephantiasis caused by filaria elsewhere in the Pacific area."

In a note dealing with this particular aspect of the survey, Dr. E. Massal, Executive Officer for Health, South Pacific Commission, expresses the hope that the preliminary study of a degeneration of the choroid, possibly of filarial aetiology, will be followed by a detailed investigation, the results of which would be most valuable.

Dr. Crawford recommends in his report on the survey that attempts be made to study the choroidal degeneration found on Truk and adjacent islands. This, he recommends, should involve the joint efforts of an ophthalmologist, a parasitologist and the local health officer.

* The survey was carried out as part of the public health programme of the South Pacific Commission. The report is published in the Commission's Technical Paper series (No. 67).—Editor.

Cacao Propagation In The New Hebrides

View of the propagators, Tagabe station.

By G. LODS

Director of Agriculture,

Condominium of the New Hebrides.

Planters in Pacific cocoa-growing areas will study with interest this practical article by Monsieur Lods on a method of vegetatively propagating cacao that has already made possible the distribution of 350 cuttings weekly by the Condominium's agricultural station at Tagabè. Type of cacao propagated is a "Criollo x Forastero" hybrid whose round, smooth pods and small but uniformly-coloured beans are close to the "Forastero" type.

FOR a long time rooting cacao cuttings was considered a very difficult, even an almost impossible, task. It is only in the comparatively recent past that this work was recognised as feasible, and it is now possible to do it on a large scale.

The trials undertaken for the past year at the Agricultural Station of the New Hebrides Condominium at Tagabè, near Port Vila, have shown that by following a special technique it is comparatively simple to get such cuttings to root. However, much care is required, and a good practical knowledge of the operation should first be acquired if a reasonable percentage of successes is to result regularly.

Some recent results obtained at the Tagabè Agricultural Station are given in the table below:

No. OF CUTTINGS	*ROOTED CUTTINGS*	*SUCCESSFUL CUTTINGS*
100	89	75
100	90	60
100	94	91
100	75	65
100	96	75
100	88	76
100	78	62
100	97	86
100	80	65
100	90	80

This success has been possible only by ensuring that certain well-determined types of cuttings are used exclusively, that they are treated with a suitable growth hormone, and that they are maintained in an environment which allows them to keep their foliage.

Types of Cuttings to Use

The growth of the cacao tree is irregular. It is subject to vegetative spurts which may occur at any period of the year, even when the tree is in full bloom or bearing fruit. The frequency and importance of these vegetative spurts depend mainly on rainfall and the condition of the tree.

The shoots sent out are either slanting or horizontal leaders or laterals, growing at the extremity of the branches or sometimes at the axilla of old leaves, or vertical water shoots growing directly on the trunk or on the main branches.

Both types of shoots can be used for cuttings, provided they are young and reasonably vigorous. The cutting should be taken at the time when the water shoots and young leaders and laterals are completely formed, and the terminal leaf bud has opened and shows several young reddish leaves. The foot of the cutting should be barely mature, i.e., at the stage when its colour changes from green to bronze. The leaves must be completely developed but they should not tear when rubbed.

If younger cuttings were taken, they would lack resistance, while with older cuttings, taken when the foot is brown and the leaves rigid, the rooting process would be long, irregular and poorly developed.

A good cacao cutting must have a diameter at the foot of between ½" to ¾", with wide leaves and moderately spaced internodes, allowing the retention of four leaves for a cutting of about 8". With long slender cuttings with narrow leaves and long internodes, as well as cuttings with leaves very close together, rooting seldom occurs and is unsatisfactory when it does.

Although the percentage of success is no higher, water shoots should be used for preference because their practice of sending out one or two more developed roots which take the place of a tap root is an advantage. This formation of pseudo tap-root is seldom observed with cuttings taken from leaders and laterals.

This is not the only advantage offered by water shoot cuttings. Since the terminal bud of the cutting is always cut off, it throws a lateral shoot which, in the case of suckers, grows vertically, thus providing a regularly-shaped tree. On the other hand a cutting from a leader or lateral shoots obliquely as a simple branch, promoting an abnormally-shaped tree, almost without a trunk and with deficient rooting.

Although normally shaped, the trees obtained from water shoots tend to become naturally low-spreading due to the fact that the laterals start too near the

Left: Type of lateral which could be used as cutting. Right: Type of water-shoot which could be used as cutting.

ground — between 12 and 24 inches above ground level. This can be remedied by pinching out the lower lateral shoots as soon as they appear so as to promote the growth of a new and large shoot in the axil of the upper leaf. A normal length of trunk can be obtained in this way.

Cuttings should be taken only from trees with desirable characteristics, which further limits the number of cuttings obtainable. In fact, under ordinary plantation management the growth of material suitable for cuttings is seldom encouraged, but by special attention it is possible to increase the number of cuttings becoming available; thus a severe pruning by promoting a vigorous surge of vegetation will allow a number of water shoots to grow. Moderate pruning, on the other hand, will promote only the growth of new branches.

The Use of Growth Substances

The rooting of cacao cuttings can indeed be obtained without prior treatment with growth substances. However, the roots produced are few and weak, and it is not usual to obtain final rooting of such cuttings.

Growth substances are also called, by extension, "hormones." In fact they are hetero-auxins, which act as an excitant on one or another of the vegetal functions— in this case the growth of roots, which they stimulate while giving it more development and strength. The percentage of rooting may thus be regularised and increased and the use of these substances is a guarantee of success.

These hormones may be obtained commercially in the form of powders, liquids or pellets to be used in solution. The method varies according to the form of the product.

With liquid preparations, one may either dip ½" to 1" of the foot of the cuttings very briefly (from 1-2 seconds), in the pure product or a highly concentrated solution of it, or soak the cuttings from 12-48 hours in a very diluted solution.

The first method has given us the best results. Protracted soaking, even in a highly diluted solution, sometimes has contrary effects, perhaps due to over-absorption of the active product.

In powder form, the hormones are used to coat the base of the cuttings. In this case the dry treatment is preferable to that of applying the powder after a preliminary wetting of the wood. This latter method promotes the adherence of too large a quantity of powder at the foot of the cutting.

During the trials made in Tagabè, about ten commercial hormones have been used. The results have been highly variable although practically all the hormones tried have the same active principle, 3-indole-butyric acid. The best results have been obtained with indole-butyric acid in an alcoholic solution and with a commercial hormone made in France and called "Exuberone."

With indole-butyric acid used by briefly dipping the base of cuttings in the solution as indicated above, rooting is satisfactory, but the final "take" is weak. During the most recent trials at Tagabè, the average rooting percentage of cuttings treated with this product was 60% with a maximum of 92%.

These results, however, are much inferior to those obtained with "Exuberone." Three types of this latter product have in fact been tested: liquid "Exuberone" which gave results comparable to those obtained with indole-butyric acid; powdered "Exuberone H" which gave regular rooting of a high percentage of cuttings but a low percentage of final "takes"; and "Exuberone V," which gave excellent and vigorous rooting of a very high proportion of cuttings, which "took" well. I have obtained on several occasions 98% and even 100% success in rooting and the percentage seldom dropped below 60% even when other conditions were unfavourable.

The rate of final "takes," still irregular, oscillates between 50% and 90%, with occasionally high losses of otherwise well-rooted cuttings. This certainly results from a lack of knowledge of the conditions required when potting the rooted cuttings. When these conditions are known—and this is the aim of current observations—it is probable that the present maximum of 90% success will become an average.

It should be mentioned here that a commercial hormone called "Formula 400," which gave the best results in New Guinea, was tried unsuccessfully at Tagabè. This failure could probably be explained by a defective detail in our utilization of this product.

Only "Exuberone V" is now used at Tagabè, but other hormones will be tested and products already used without great success will be tested again. In fact it is quite possible that some deficiency in our rooting technique may have proved a drawback in their case at the beginning of our trials.

Maintaining the Leaves of Cuttings

Maintaining the leaves of the cuttings is probably the greatest factor to success in cacao rooting. Indeed, while the use of hormones facilitates and increases rooting and the later establishment of the plant, this is only actually possible when at least one leaf, and preferably several, persist on the cutting for a reasonably long time. This is explained by the fact that the food reserves of the young cutting are insufficient to promote both the survival of the cutting and the formation of roots. These reserves should therefore be supplemented by the chlorophyll activity of leaves which, through photo-synthesis, produce new foods.

Cacao cuttings never survive total defoliation. If this happens before the complete formation of a new shoot, the chances of starting the cutting are diminished, even if roots have already formed. In this latter case the young shoot may start up, but it is sickly and short lived. If defoliation occurs during the 20 days following the installation of the cutting in the propagator it is wise to take it out, since it will rot and might contaminate surrounding cuttings.

In order to keep the leaves on the cuttings, these should be placed in a glass propagator for approximately four weeks. They find there a confined environment where humidity, light and temperature are combined in order to give the best chances of success.

The propagators used at Tagabè are reproduced in all respects except their dimensions from those developed in Trinidad. They are merely concrete boxes, 2.70 metres (9') in length and 0.95 metres (3' 2") wide. The sides are 0.55 metres (1' 10") in height on one side and 0.40 metres (1' 4") on the other. On these rest four glass frames

Left: Cutting immediately after being taken from tree. Centre: Same cutting ready for setting in propagator. Box in operator's left hand contains powdered hormone for applying to foot of cutting. Right: Root formation of cuttings after 14, 16 and 26 days in propagator.

assuring a good closure of the propagators. The bottom of the boxes is made of a layer of rocks, 4" to 5" deep, covering a drainage pit dug in the centre of each propagator to ensure the regular drainage which frequent, and sometimes generous, waterings necessitate. Any excess of water should be rapidly eliminated.

Over the rocks is placed a layer of coral sand from 8" to 10" deep, in which the cuttings are planted. This rooting medium was chosen despite the serious inconvenience resulting from the fact that it provides no food whatever to the young cutting. The latter should therefore be taken out as soon as the roots are sufficiently formed to fulfil their functions.

Better results might perhaps be obtained with decaying vegetable substances such as sawdust, soft rotten wood or coconut husks which could feed the cutting and allow it to acquire some strength before potting. However, it is difficult to obtain some of these materials in sufficient quantities in the New Hebrides, or else their preparation often takes too long. As for rotten leaf mould and light earth, they provoked root rot whenever used.

Several types of sand were tried, coral sand, either fine or coarse, volcanic sand, pulverised pumice. The best results were obtained with coarse coral sand, which has the advantage of not tamping down after watering. It drains easily and offers always a well aerated medium. It should, however, be renewed every four to five months, otherwise it might clog up.

Best Conditions for Rooting Cuttings

The atmosphere inside the propagators should at all times be moisture-saturated, although the sand should not be waterlogged. This requires careful attention to frequency and extent of the waterings, which should be adapted both to atmospheric conditions and the age of the cuttings. This was determined only by trial and error and long practice. Insufficient watering shortly before or at the time the roots appear, hinders their formation. In this case a thick scar tissue appears at the foot of the cutting, without any roots. Although the cuttings on which this callus is observed may be of good appearance and strength and may be potted and kept in the rooting propagators for some long time, they very seldom take root. During the last ten days an excess of water is damaging, promoting root rot which later extends to the whole of the cutting.

At Tagabè, very little water is applied for the first two days after putting the cuttings in the propagators and the amount is increased gradually until it becomes copious on the fourteenth day. The waterings then decrease and only light waterings are applied at the end of the fourth week. On rainy or merely overcast days, a single daily watering is sufficient. On sunny days two generous waterings per day are necessary, and on a particularly hot day quick wettings should be applied in addition, to maintain the freshness of the foliage and atmosphere without increasing the humidity of the sand. The development of these watering techniques required long trials.

Extensive experiments were also necessary to determine, without the benefit of any meters, the amount of light which should be given to the cuttings. On the light density depends the persistence of the leaves and their chlorophyll activity and hence the possibilities of rooting the cuttings. Grossly insufficient lighting quickly promotes chlorosis and complete defoliation. Merely insufficient lighting will allow the leaves to persist, but no roots will appear. Excess of light will result in a premature ageing of the leaves but is less damaging than an insufficiency of light. In the weather remains overcast for too long, the failure of rooting is certain.

At Tagabè, where the propagators are set out in four parallel rows in a north-south direction, the results are regularly better in the propagators of the side rows which receive the rays of the sun for a brief period, either early in the morning or late in the afternoon.

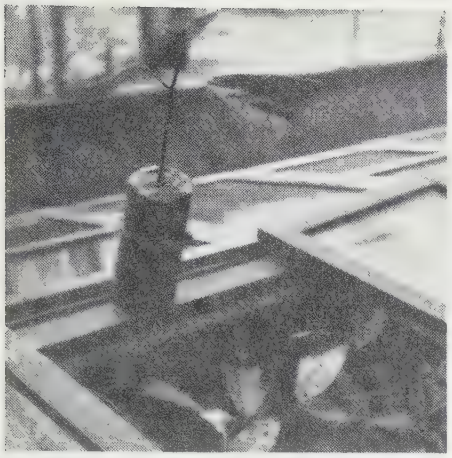
It appears that the danger of overlighting is mostly due to the increase in temperature caused by the green-house effect, which may be quick and considerable. In fact, the internal temperature of the propagators should not exceed 31 C. (88 F.) and this temperature is soon reached on bright days if one is not careful. The optimum temperature appears to be between 26 and 30°C. (79 F. and 86 F.).

Light is controlled through a shelter installation. Indeed, natural shade from large trees should not be sought. It is too irregular and may, in the same day, be too dense at times and insufficient at others. Coconut leaf or split bamboo shelters also have numerous drawbacks. The type of shelter at present adopted at Tagabè is therefore made of sacking spread approximately two metres (6' 8") above the propagators. This filters and diffuses the light. A single thickness is normally sufficient, and a second should be added only on particularly bright days. In addition, on very hot days one thickness of cheese cloth should be laid on the glass panes of the propagators. This material should be kept damp in order to prevent any dangerous increase in temperature.

The exact determination of the three factors, humidity, light and temperature, is the delicate point in rooting cuttings, and long practice is required to secure the optimum effect from these factors as in each case the optimum appears to be confined within rather narrow limits.

Some Practical Details

The cuttings which give the best success are those taken after two or three hours of sunlight, during the early part of the day. The results are not so good



Left: Potted cutting. Centre: Showing development of root system of cutting ready for distribution. Right: A four-months-old seedling is shown on the left; four-months-old cutting at right.

when they are taken very early in the morning.

The whole water-shoot is taken, although care is exercised not to cut it right at the trunk. The stub left there allows for a quick growth of new suckers.

The cutting is trimmed to the required dimensions only when about to be treated with hormones. Seldom does one shoot provide more than one cutting. Each cutting is, in fact, taken from the most suitable part of each shoot, either the top or base according to the age and size of the shoot.

Four leaves are normally kept on a cutting measuring from 8" to 10", according to the length of internodes. By keeping more leaves, the chances of success would be increased but the number of cuttings placed in each propagator would have to be reduced. In fact, the leaves left on the cuttings should not overlap and this would happen if they were set too close together.

The practice of the "single leaf cutting" which consists in rooting a sliver of internode with one leaf, did not appeal to us. In fact, the fall of the single leaf is frequent and involves high losses. This technique requires much more care and makes for only a slight economy of cuttings.

On the type of cutting used at Tagabè each leaf is cut at 1/3 or ½ of its length. If the leaves are left whole, their survival is shorter.

The base of the cutting should be cut neatly in a long slant. This section must be retrimmed before applying hormone. Immediately after this treatment the cuttings are set in holes from 4" to 6" deep, prepared in the sand of the propagators. These holes are from 4" to 6" apart.

A propagator of the size indicated above contains from 100 to 120 cuttings, according to the amount of their foliage. The beginning of the rooting process can be observed around the tenth day as the formation of scar tissue on the lips of the section. Gradually this tissue covers all the cut end. Above this scar there appears a swelling where rudimentary roots begin showing around the fourteenth day. Under favourable conditions, the growth of these roots is quick. Some may even reach 4" in length in ten days. At the beginning, all these roots grow horizontally or obliquely. In the case of water-shoots one, or sometimes two, roots later strike down and attain a greater development than the others, which remain slender and creeping. The root hairs appear around the end of the fourth week and the cuttings are then potted.

Bamboo internodes are used for pots at Tagabè, although they have the inconvenience of being too small to hold the cuttings for a sufficient time before the final setting out. These pots are filled with a mixture of three parts crushed pumice and one part of black soil rich in organic matter, to which a very slight dose of fertilizer is added. During trial this medium has given the best results.

Once potted, the cuttings are placed in a propagator identical with that used for rooting, but containing neither sand nor rocks. The depth of these propagators is calculated so that the foliage of the cuttings is as near the glass panes as possible, being therefore well-lighted. Indeed, if the lighting is insufficient the leaves turn a lighter shade, fall and the cutting is lost.

For the first five days after setting the pots in the propagator this latter is kept closed, except of course during watering periods. Later on it is opened gradually until the fourteenth day, when it is left completely open. In fact, for the first few days after potting, rooted cuttings must be maintained under conditions similar to those experienced during the root formation period. The cuttings should only be exposed gradually to the open air afterwards.

The cuttings should be only lightly watered at the time of potting. Later, two or three light waterings are given daily in order to keep the leaves and the soil fresh without any excess moisture. An excess of water would encourage root rot. Losses after potting are generally higher than during the rooting period; 60% - 95% of rooted cuttings survive potting.

Setting Out in the Nursery

The third and last stage is the setting out in the nursery, during which the pots are placed in the open air but in a sheltered place. This nursery stage does not require much care, provided one always remembers that the young plants are not yet very resistant, and highly sensitive to strong sunlight or heavy rains.

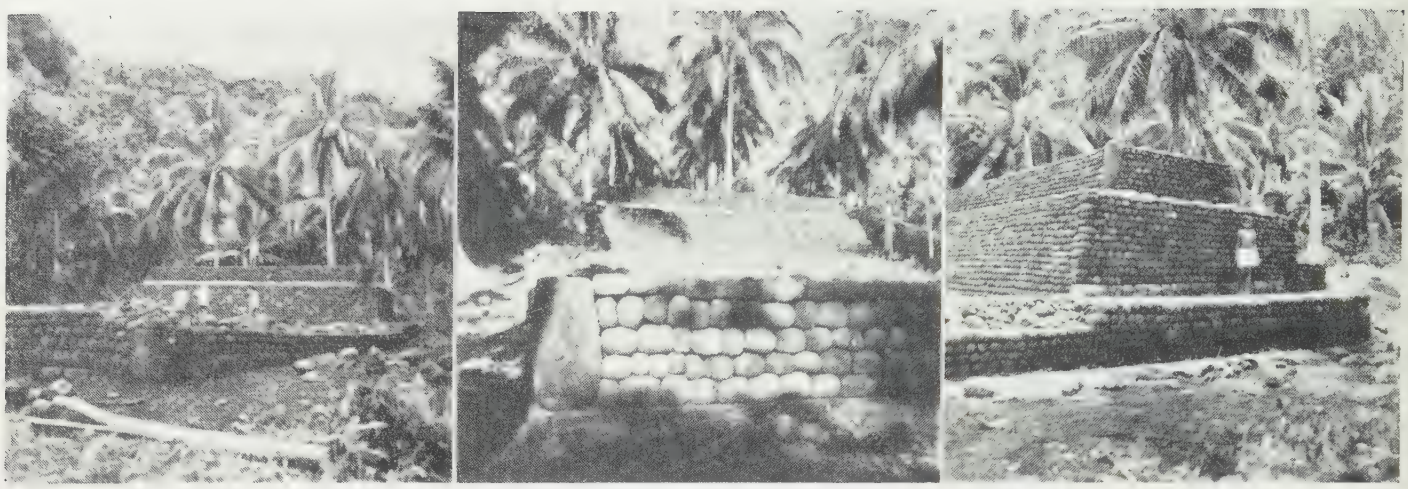
It is during the stay in the nursery that the growth of the buds formed at the end of the rooting stage occurs. As for the roots, they quickly push out of the bottom of the pot.

After a month in the nursery the plant is sufficiently hardened to be set out under suitable shade.

Cocoa Experiments in Fiji

ABOUT 16,000 cocoa seedlings will be available at the Plant Introduction Station at Naduruloulou this year for planting out in various parts of the Colony. A nursery has been established by the Department of Agriculture at Korovou, Tailevu, and nearly five acres have been planted in production plots. The Fijian Banana Ventures propose to prepare 50 acres at Sawakasa, Tailevu, for cocoa planting and it is hoped that 4,000 trees will be planted this year on properties in Vanua Levu and Taveuni.

Proposals for developing cocoa growing among Fijians have been made to the Secretary for Fijian Affairs. Old cocoa plantings in Viti Levu and in Cakaudrove Province (including Taveuni) have been surveyed by the Department of Agriculture and some useful trees have been recorded.



Left: A general view of the marae. In the foreground is the surrounding wall with the "paepae" behind, in the background, the "ahu." Centre: Detail of the surrounding wall, showing the layers of cut stones, the corner stone and basalt slabs of the foundations. Right: The "ahu" and its three steps.

Restoration Of Marae In Tahiti

By HENRI JACQUIER

Chairman of the Societe d'Etudes Oceaniennes

*A grant-in-aid was made in 1952 to the Société d'Etudes Océaniennes by the South Pacific Commission for archaeological work.**

IT was felt by the Committee of the Society that the money could not be better used than for the purpose of clearing and rebuilding one of the Tahitian marae which, if neglected much longer, could disappear completely from both this world and human memory.

The Arahurahu marae, at Paea, was selected as being comparatively undamaged and of easy access: it is mentioned in Emory's excellent work *Stone Remains in the Society Islands* as being "in a rather good state of preservation" in 1925;[1] though of course it is only relatively so, after more than a century of neglect. The plan meticulously drawn by this author was used as a starting point.

Before giving details of the restoration work we must define what a marae was, since at the present time most of the people residing in Tahiti, and even many Tahitians, do not know what these monuments were and what they represented.

De Bovis gives an exact definition of the marae—"the open air temple of Polynesian religion." Tahitians indeed—in spite of the opinion spread by philosophers round the end of the 18th century—were a deeply religious people. They built these marae everywhere, and they are found on the shore as well as in valleys and even upon the mountains.

Schematically, the marae consisted of a platform of stones, of varying height, called *Ahu*, and of an oblong paved yard enclosing the *Ahu* and surrounded by a wall, forming the *Paepae*. The dimensions were extremely variable; for example, the *Ahu* could be from barely three feet up to forty-five feet and over in height.

In Tahiti and Moorea, the *Ahu* was a pyramid of steps with an oblong base, usually built of basaltic rocks specially selected or cut. Shaped blocks of coral were incorporated, but formed seldom more than one or two layers. By contrast, in the Leeward Islands the *Ahu* was almost solely constructed out of enormous coral slabs raised on end, the interior being then filled with stones and coral rubble.

The enclosure of the marae was sacred and the altar or *Ahu* was the especially taboo part of it. Nobody ever climbed its steps except for the idol bearers and visionaries in trances who were themselves taboo at that time.

In the yard, facing the *Ahu*, were one or more stones raised on end between the paving slabs. These were called *Turui* and were used as backrests by leading personalities attending the ceremonies. There were a variety of different ceremonies and these depended on the class of marae. Four main classes were recognized. These were: the royal or national marae generally located on promontories; votive marae raised in memory of a hero or god; kinship marae; and guild marae—especially for fishermen and canoe builders.

Marae An Essential Part of Tahitian Life

It can thus be seen that the marae played an essential part in the life of the Tahitian people. It was in a way the representation in material form of the social, kinship and occupational groups. A man would not say "I am from such and such a district" but "I am from such and such a marae."

Many of these marae were dedicated to the God Oro, but some were dedicated to Tane, a particularly bloodthirsty divinity requiring human sacrifices.

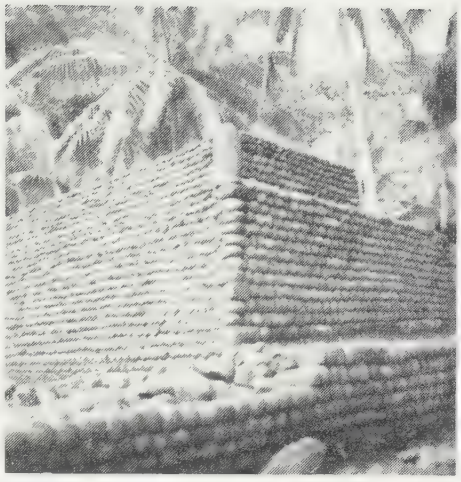
In principle the marae, and especially the national ones, were used for every manifestation of religious and political life. There, the gods were honoured with prayers and offerings, the kings and chiefs were consecrated, war or peace was decided upon according to the omens observed by the priest: in short, they played approximately the same part as the temples of ancient Greece.

During the ceremonies, the high priest, assisted by the *Orero* and *Harepo*, officiated at the foot of the *Ahu*, facing the yard. Offerings were laid out on wooden platforms called *Fata* and placed outside the enclosure. The chiefs and noblemen sat on the *Paepae* according to a hierarchic arrangement which was rigorously

* The accompanying article was published in **Nouvelles Tahitiennes** for February, 1954. It is reproduced here by courtesy of the author, M. Jacquier, and the Editor of the Department of Information, Tahiti.—Editor.

1 EMORY, KENNETH P.: **Stone Remains in the Society Islands.** Honolulu, Bishop Museum, 1933. 182 p. (The Museum's Bulletin, No. 116.)

Left: Detail of the "ahu." Right: Detail of one corner of the surrounding wall.



determined by a protocol which would have borne comparison with that of Louis XIV. The crowd stood respectfully at a distance and women were not admitted.

Human victims, if any, were never exposed on the *Fata*; they were trussed up in a coconut leaf basket and laid down in front of the *Ahu*. After the ceremony, they were buried behind the altar.

After these sacrifices, or sometimes in memory of a hero, a carved board of *miro* wood approximately six feet long and coloured with ochre, called *Unu*, was set in the enclosure. The drawings of the first navigators show us some famous marae where the enclosures were veritable forests of *Unu*.

But to conclude this brief review of the role and appearance of a marae and come back to the Arahurahu marae which is of particular interest to us. It is located in the Paea district, about a quarter of a mile from the circular road, at a point 14 miles from Papeete. It is 103 feet long, and 54 feet wide. The *Ahu* had three steps slightly under 12 feet in height. It was built almost entirely and with great care of basalt stones shaped like prisms with a rounded base. The land it stands on, which is comparatively easy of access, now belongs to Mr. René Passard, who helped us greatly in the matter of restoring the marae.

The first thing to be done was to clear the monument of all the vegetation with which it was overgrown, including coconut palms and puraos, the roots of which were rather difficult to get out. A twenty-inch layer of alluvial soil was then shovelled off to uncover the foundations of the marae, made of basalt slabs cut square and recalling the shape of a pavement. Next, the fallen stones were replaced one by one on the enclosure wall and on the *Ahu*.

The work was by now well advanced, but about a thousand shaped stones were missing, carried away by floods or buried in the ground in the course of a century. As already mentioned, these stones have a very peculiar shape, and similar ones can be found in other ruins and in particular in the half-fallen *Ahu* of the Narii or Pihoro marae which is also located at Paea, approximately in front of the school. We thought that some stones might be obtained there, especially since present buildings in the vicinity have drawn freely from these ruins; but when it came to the point, the opposition of one of the part-owners of the land made this solution impracticable. Another source of shaped stones was known to be a ruined *Paepae* erected a few miles away in the Paea Valley. The Army authorities have given us reason to hope that the soldiers may be able to help us to transport these stones, and we are extremely grateful, as the cost of such an operation would exceed our financial resources.

This marae as it can now be seen calls to mind the Inca monuments still found in Peru. We agree with Handy that such a likeness is probably not fortuitous. There must have been contact ages ago between Eastern Polynesia and the Peru Coast, where monuments of piled up stones are still to be observed, and where human sacrifices were once practised. At the same time, this need not detract at all from the value of the classical, well-established theory that the cradle of Polynesia was in the Indian Archipelago.

We believe that this is the first instance of such a work of restoration being done; and it is certainly of great interest alike to the islander, anthropologist and the tourist.

NOTE: In a letter dated May 27, 1954, M. Jacquier notes that the restoration of the marae has progressed since this article was prepared. He writes:

> "I have had reproductions made of *Unu* and *Fatarau* and these are now in the marae yard. In addition, the *Fare Atua* has now been erected outside the enclosure, made entirely from native materials. In it is exhibited an engraving from Cook's report showing a human sacrifice which he saw not very far from the Arahurahu marae, together with a notice in French, English and Tahitian explaining what a marae was.
>
> "Next week, with the co-operation of the Army, a proper road will be built from the circular road to the marae."

"Pacific Reading"

Pacific Reading is a quarterly periodical published by the South Pacific Literature Bureau, established by the Commission to stimulate provision of literature and visual aids for island peoples. This periodical keeps those interested in touch with materials suitable for their needs.

Each issue records information from the Pacific area about work being done there in the preparation, distribution and use of new literature and visual aids. Articles by specialists are also included; while numerous books, films and filmstrips are reviewed.

The September issue contains an excellent leading article, "Hand Loom Weaving," by Mrs. P. R. McMahon, who is Editor of *The Australian Hand-Weaver and Spinner*. This article gives much helpful advice to those who wish to learn or teach hand loom weaving, and includes a selective book list for further reading. Another article deals with problems likely to be encountered by anyone who starts a bookshop for islanders. A third article discusses the results of an essay competition on the subject, "Some Books I Have Enjoyed," recently held in Papua and New Guinea.

Pacific Reading is published in March, June, September and December. Subscription rates are: Single copy, stg. 2/-; annual subscription, stg. 6/-; annual subscription for ten or more subscriptions sent to the same address, stg. 5/-. Subscriptions may be sent either to the Secretary-General in Noumea, or to the Executive Officer for Social Development, Box 5254, G.P.O., Sydney, N.S.W., Australia. There is an English and a French edition.

Food Technologist Engaged

DR. H. S. McKee arrived at Commission headquarters in Nouméa on 30th September to take up his duties as food technologist. In consultation with territorial authorities he will study improved methods of preserving, packing, storing and transporting foods and the development of food processing industries.

Dr. McKee has been with the Division of Food Preservation and Transport in the Commonwealth Scientific Industrial Research Organization, Australia, since 1940. During the war he was a scientific adviser to the Australian Army in New Guinea, being concerned mainly with losses and deterioration in canned and dehydrated foods.

Mechanized Rice Production In Papua and New Guinea

From a rural broadcast by the Department of Agriculture, Stock, and Fisheries, Port Moresby.

CONSIDERABLE progress has been made in the territory of Papua and New Guinea in the last two years by growers who are interested in the mechanized production of rice; and there are signs that the industry is becoming firmly established in at least two areas, the Markham Valley and the Mekeo. This article aims to review briefly the methods recommended for growers at the present time, and some of the problems associated with the developing industry. All references are to the dry system of production, since favourable conditions for irrigation have not yet been located in accessible areas.

The first phase in the development of a rice growing area is the initial land preparation. Because of the cost of clearing, grasslands are virtually the only type of country being opened up for rice farming. These in their natural condition are found to have a dense cover of coarse fibrous grass, either of the shorter types such as kunai or the taller types such as cane-grass. The above-ground part of this cover must be removed to permit the use of agricultural implements on the land, and burning is recommended. Growers should avoid the high costs of uncontrolled burning or of slashing by hand to promote a burn. The best technique is mechanically to roll the grass flat on the area to be cultivated, and then burn after a period of a week or so for drying out of the broken stalks. This will be found to give a very uniform burn. Suitable rollers for towing behind a tractor can be cheaply improvised by welding strips of angle iron or steel rail on to 44-gallon drums, or by setting spikes in a hardwood log selected for its cylindrical shape.

On completion of the preliminary burning, the land will be found to be carrying a heavy content of coarse fibrous material in the form of grass stalks and roots, and this must be reduced by ploughing. Disc ploughs are recommended, and the heavy-bodied types should be used if possible. Heavy ploughs built on the spring-controlled disc principle such as the Australian "Majestic" plough have done the best work in the Department of Agriculture trials. Ploughs should be set to work deep enough to ensure that all grass roots are taken and turned up towards the surface, where they can be chopped up by further tillage operations.

Right: During the recent rice-growing season in the Mekeo area, the tractor shown at top was in service for 395 hours on ploughing (with three-disc plough, centre), cultivating (with disc harrows, bottom) and planting.

Initial ploughing should be followed by cross-ploughing and several cultivations with conventional tillage implements such as disc harrows. The aim of these operations is twofold—both to kill out the native coarse grasses, and to promote the digestion in the soil of the great bulk of fibre left behind by their roots and stalks. This initial work should always be done at least six months, and preferably nine months, before the sowing of the first crop, otherwise this crop will be very disappointing, varying from patches which have run to too much stalk and leaf to patches which are stunted and low yielding, and will inevitably be heavily infested with native grasses. An alternative is to grow a heavy-feeding smothering crop, such as sweet potato, immediately after the land is first opened up.

These opening-up operations are the most expensive phase in the development of rice farming, and growers should plan them very carefully and give careful thought to the purchase of the necessary implements. Conventional disc ploughs, which on present experience are essential for the control of native grasses, are slow moving with a comparatively narrow cut. It is considered that, on properly-managed land, the use of such ploughs will be necessary only once every three or four years. Ideally, therefore, groups of growers should combine to split the cost of such equipment.

Rice needs a carefully prepared seedbed, and should never be sown into land where weeds have already germinated. In such cases an extra harrowing should always be given. Conventional types of multi-row grain combines have proved quite satisfactory for seeding in this territory, and ensure the most effective use of prime-movers. Disc-drills are to be preferred to hoe-drills.

Much has recently been learned concerning suitable harvesting procedures for rice in the territory. The importation and trial of the open-front type of header has shown that this machine is definitely superior to types which feed the headed crop in through a winder. The open-front type machines are much better adapted to handling the heavy leaf and stalk growth of our crops. Additional equipment, such as the pick-up reel fitted with fine steel fingers and similar picking-up fingers used on the elevator canvases, is most valuable in the harvesting of fallen crops.

Growers in selecting seed, should look ahead to harvest time, when for mechanical harvesting even ripening is of great importance. The sowing of a mixture of varieties, or of a variety known to ripen unevenly, should be avoided. Where a crop is ripening unevenly, as sometimes occurs during unseasonable weather, regardless of the variety used, a mechanical windrower can be helpful. This machine mows the crop and delivers it in orderly rows across the field. The crop is allowed to ripen in these windrows, and is then harvested by an open-front header with pick-up attachments.

Tillage between crops, aimed at giving controlled management of the area being farmed, is considered to be of the utmost importance. The practice of leaving land untouched between crops leads to the re-establishment of native grasses and the costly use of the plough before a new crop can be safely sown. Tillage implements such as disc harrows and disc tillers are fast moving, with far wider cuts than ploughs of the same draft, and very economical to operate. The aim in using them should not be to maintain a bare surface during the inter-crop period, but to reduce all volunteer growth at

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Top: Seedling nursery in Rarotonga. Varieties shown include Albizzia falcata, Pandanus, and Cedrela odorata. Bottom: Albizzia planted six feet apart, after two years' growth.

Afforestation In The Cook Islands

*This article describes the re-afforestation programme being carried out on Atiu and Rarotonga in the Cook Group. Main plantings are of trees of potential economic value, notably Albizzia falcata, for use as a case-wood timber.**

By R. G. THORBY

Resident Agent at Atiu

ONE has only to survey the vast area of fern land on the Island of Atiu to realize that no effort should be spared at rehabilitation in some shape or form before the several thousand acres become irremediably ruined. Yearly, thoughtless burning and the resultant incipient erosion may, if not arrested, leave much of the land beyond a state of productivity.

In 1951 a small scheme was worked out among local people as to how to set about this task. Many difficulties were confronted and in the absence of expert advice we had to go carefully, because the scheme envisaged had, at that stage, to be carried out entirely by the people. It is an incautious man who will give up his land to plant trees unless some form of future planning is laid down and a measure of return promised. To the Maori people it was useless to continue pointing out erosion and the eventual consequences.

Having overcome the land problems in which owners co-operated readily we decided to try the case wood timber—*Albizzia falcata*—as this variety had already been grown in Rarotonga. During 1951 a small stand of one thousand trees supplied from Rarotonga had been established, but owing to staffing difficulties the proposed scheme was not taken up again until August, 1952. During this period the few trees had done remarkably well, and on resumption of activities the people were informed that some assistance had been granted by the Government and that it was proposed to start an Afforestation Nursery in which other varieties would be tried for suitability.

In order to gauge the earlier interest of the people a notice was circulated asking planters to stipulate the area they would be prepared to give up for the growing of trees. In less than one week 330 acres on the central plateau and the slopes extending towards the Makatea had been offered. Since that time additional land has been offered. Here was an opportunity for a tree lover to grasp with both hands.

Before setting out the detailed steps of the scheme, it would be well to make quite clear the responsibility of the people taking part in reafforestation.

Owners of land which is practically useless in its present state for the production of food crops are, after discing of the more heavily fern-clad areas, required to dig holes in true alignment, prepare stout stakes for the more exposed positions and cut fire breaks. Unless this is done to the satisfaction of an overseer, no trees are issued from the nurseries. After-care also has to be carried out, such as re-staking where necessary, maintaining the fire breaks and replacement of dead trees. Generally speaking the work is well carried out, but strict supervision has been necessary in some cases.

Nursery Practice and Varieties Under Cultivation

The growing of *Albizzia falcata* and *Albizzia lebbek* is not difficult.

The seed, after pre-soaking, is sown in slightly-raised beds, and when seedlings are four inches high they are individually transferred to coconut shells which have been filled with soil of a high humus content. The young potted seedlings are returned to nursery beds at a distance of three inches between shells with a distance of nine inches to one foot between rows, the shell being buried in the soil up to the lip or rim. This allows light cultivation of the surrounding soil and enables the beds to be kept free of weeds. During hot weather it is usual to cover seed-beds with kikau (coconut palm leaves) which are placed on frames approximately five feet high. Care must be taken, however, to remove the shade once the seedlings have taken root, as subsequent hardening off is necessary, since the young trees have a good deal to withstand on the arid areas if a dry spell is experienced after transfer to forest plots.

With normal conditions the young trees are ready for their final transplanting in 4½ to 5 months and care is necessary when lifting to keep the coconut shell intact, thus allowing a reasonable amount of good soil to give the tree a start in its new environment. By the end of six months the shell has disintegrated and does not hamper the root growth in any way.

Many thousands of shells are required but a system has been locally devised whereby the school children gather all sound shells which are collected and

* The establishment of local sources of supply of case timber is important in the Cook Group, which exports fruit and vegetables extensively to New Zealand (1952 shipments totalled 136,000 cases, mainly of oranges and tomatoes).—Editor.

taken to the nurseries. This co-operation has the twofold advantage of not only helping nursery work considerably, but denies the mosquitoes of favourable breeding places and assists in the removal of unsightly rubbish.

EUCALYPTS

Attention to other types other than case-wood trees has brought encouraging results. Varieties of Eucalypts are now established, principally *E. saligna* or Sydney gum, and *E. ficifolia*. The planting of this minute seed directly into beds did not meet with much success, and far better results were obtained from plantings made in boxes. A consistently moist soil was found to be necessary during the early stages, otherwise losses occurred. When the seedlings are sufficiently strong to transplant they are transferred to coconut shells and treated in the same manner as the *Albizzia* varieties. The variety of *Eucalyptus saligna* is now six feet in height and is a strikingly handsome tree, more so in company with some of the indigenous varieties such as Toa (Casuarina).

ACACIAS

Remarkable growth has been made by some small *Acacia decurrens* (Black Wattle) and *Acacia baileyana* (Cootamundra Wattle) which were brought from New Zealand in October, 1951. Both varieties have flowered and seed has germinated freely. The former variety makes splendid shelter and indications are that it will surpass the *Eugenia jambolona* (Pistache) which is used extensively around Citrus plantations as a windbreak. *Acacia baileyana* is of more ornamental value and the long sprays of golden blossoms are greatly admired. This variety, however, is too "open" in habit and does not like the exposed conditions, but is a decided acquisition to the landscape, and so far has stood up well to the poor laterite soil. *Cedrela odorata*. Spanish cedar, commonly known as Toon tree.

This is a recent introduction which is making encouraging growth especially on better land which has a higher moisture content. Seed is easily grown and the same treatment as for the *Albizzia* varieties has been successful.

New species about to be planted include *Rhus taitensis* which is said to be of value as a box-wood timber; *Tectona grandis* (Teak) which has to be planted on selected areas near Makatea owing to the requirements of a calcareous soil; and *Gmelina arborea*, described as a large timber tree of rapid growth. It has been recommended that trials be carried out with the following: *Pinus markusii*, *Pinus taeda*, *Araucaria excelsa*, *Araucaria bidwillii* and the Eucalpts, *E. deglupta* and *E. microcorys*.

Many other types of botanically authenticated specimens have been suggested and as time permits experiments will be tried to see if they will thrive on the red brown lateritic soils derived from the basaltic rocks underlying them.

The propagation of indigenous varieties, so often wantonly chopped out, is also receiving attention. The older Maori people speak of the amount of Miro, Toa, and Tamanu which in years gone by grew in large quantities on the fringe of the Makatea. All three species produce valuable building and furniture timber and are resistant to termites. A small area containing all three types has been planted and while of comparatively slow growth in comparison with case-wood timber, Eucalypts and Acacia, the result is encouraging.

Toa (Casuarina or Ironwood) interplanted with Eucalypts present a contrasting and splendid sight. The former, self-sown, grow in great numbers on the lower slopes of the central plateau and since the stern attitude taken as regards burning, considerable areas may be said to be rehabilitating themselves.

Nursery work has been carried out by two Maori employees with the assistance of the writer when time from administrative duties permitted. This was an entirely new type of work to both local men and any success is largely attributable to their industry, interest, and ability to observe. In looking back it is unanimously agreed that we all know a good deal more about this pleasant and gratifying undertaking than we did two years ago. The greatest satisfaction, however, will come when some contribution has thereby been made to the development of other insular economies.

Nurseries have also been established in Rarotonga and land owners have made a start at establishing stands of case-wood trees, but as most of the land at the foot of the central mountain range is cultivable and grows economic crops, it may be some time before the steeper slopes are won from the staghorn fern which has taken possession. An extension of the scheme on Atiu will prove of valuable assistance and may bring about a fuller acceptance of reafforestation by the people of Rarotonga. Much time can be saved by experimenting with various varieties and finding out which of those will be of economic value and in turn passing on the result of our findings.

In 1953 we received a visit from Mr. W. H. Jolliffe of the New Zealand Forest Service and this added impetus to the already mounting interest. A survey of forestry possibilities on both Atiu and Rarotonga was undertaken and much valuable advice was given. We had reached a stage on Atiu where specialist advice was necessary if we were to continue and expand our efforts. It is true to say that enthusiasm had carried us a considerable way, but the time had come when difficulties could not be overcome by idealistic plans which lacked fundamental knowledge. There was, too, the aspect that the best results should be obtained for the money advanced by the Government if additional help was to be received.

Today, less than two years since any sustained effort was put into the project, over forty acres have been planted and thousands of seedlings are in various stages of development. The number of trees on plots is approximately 26,000.

A new nursery of some 4½ acres has been established and more land has been made available for planting of forest plots. At the moment almost seven acres have been prepared to receive trees—the land has been disced and the holes dug and stakes have been driven. As soon as rains come, several prospective plot owners will have to be busy.

Quite apart from the satisfaction of seeing large unsightly areas becoming slowly clothed in trees of potential economic value there are the many fundamental issues which have to be considered.

The deforested areas and sheet washed slopes bear witness to reckless practices which are at variance with the principles of tropical land use. No good reason has ever been put forward for the past systematic burning of large areas of fern land scantily clad with Casuarina. One reason, put forward by an old man, that it was easy to gather the dead iron wood for fuel, did not impress as a logical one. The barren vistas quickly produce a denser cover of fern which is one of the few plants that survive and indeed thrive on the harsh and inclement lime exhausted soil.

As pointed out by Mr. Jolliffe in his report on forestry activities in the Cook Islands, the assessment of timber for building purposes has not yet been attempted, and at this stage the programme is largely experimental. However, with the planting of forest trees, surely will come advantages not readily seen by the native planter who uses a system of shifting agriculture.

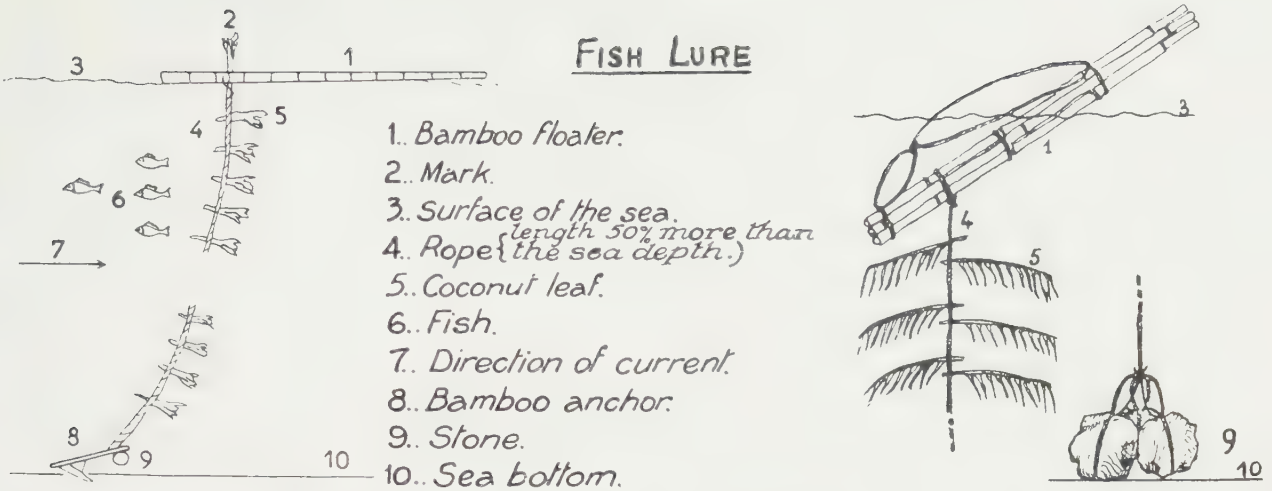
It has long been accepted that the sciences of agriculture and silviculture are inseparable, and it is abundantly clear that the full benefit of one type of endeavour cannot exist without the combination of the other under prevailing local conditions.

Mechanized Rice Production

Continued from page 14

sufficiently frequent periods to prevent the native grasses from getting established. Some breaking up of the subsurface soil to provide for aeration and drainage is desirable prior to the sowing of each new season's crop. This can be done effectively and economically using the new sub-surface tillage type of equipment such as chisel cultivators and subsurface sweeps.

Careful use of the tillage implements mentioned above should enable the grower to eliminate ploughing until after the land has been left out of crop for the inevitable rest period.



Fishing With Lure-Lines

By H. VAN PEL

Fisheries Officer, South Pacific Commission

FISH can be attracted to a given spot by several means. A very efficient one used in Indonesia is a lure-line anchored in the sea, in depths of from five to thirty fathoms.*

As the sketch above shows, the lure itself consists of a float, an anchor line to which pieces of coconut leaves are attached, and an anchor or a stone weight (I have seen long grass used instead of coconut leaves). The float is usually made of one or more bamboo sticks. The anchor line is a rope made of bamboo fibre or some other material, of a length equal to one and a half times the depth of the sea. (A depth of thirty fathoms, for instance, will require a forty-five-fathom line.) Pieces of coconut leaves (one-sixth of a frond) are pinched between the strands of the rope or attached to it every yard. Some of the old coconut leaves will have to be replaced after one or two weeks.

The anchor is made of bamboo and is weighted by stones; an excellent rig for soft bottoms. Where the sea bed is hard, however, rocks replace the bamboo anchor.

This type of lure is anchored in places where the current is slow, not exceeding two miles per hour. Upon anchoring the lure, the fishermen take bearings from shore, hills, mountains, trees or islands, in order to find the spot again.

In most cases, it takes from three to five days for the fish to approach the lure. Then fishing operations can commence, and be repeated daily. This lure mainly attracts herring, mackerel and sardine species, but small tuna and other pelagic fish also come to it sometimes. Where there is a current, the fish normally swim a short distance upstream of the lure.

This rig is not so effective in turbid water. The best fishing conditions are offered by a slight discoloration of the water, which permits fishing during the daytime. The lure is most effective in very clear water, but then net fishing can only take place at sunrise or at sunset.

A deep-sea seine (bag-net, with two wings and an underlip) or a lift-net is used with the lure.

Before fishing operations start, the lure must normally be lifted, although there are exceptions to this rule. After lifting the first ten fathoms, the fishermen undo a connection, and this top part of the line, weighted with a stone, is put in the water again, while the rest of the lure, together with the anchor, is pulled aboard the boat. The fish are now gathered near the first ten fathoms of the lure, the "room" as it is called. The "room" is then handed over to a canoe, handled by one or two men. The canoe thus acts as a float. The fishing boat then goes away from the canoe and sets its net as a surround net around the canoe. This has to be done in such a way that the bag of the seine is upstream of the lure. The reason for this is that frightened fish always tend to escape upstream. The "room" is pulled in gradually as the net is drawn and the fish follow it, coming nearer to the surface of the water. At the last moment, the "room" is pulled entirely aboard the canoe, which paddles away from the net as the last part (the bag) comes in.

Catches can vary widely. Sometimes, when the current and the winds do not agree, the net is empty. On the other hand, catches of one or two tons may be made with one lure. (I have personally made a maximum catch of two and a half tons.)

This type of fishing is suitable for motorboats, open sailboats (which are rowed during the actual fishing operations) and even for outrigger canoes. Some motor fishing boats have up to twenty lures in the sea, and sailboats may have from two to four.

I have described here only the normal application of this fishing technique, but variations can be introduced.

Those who may be interested in this type of fishing but feel that the information given is not clear enough, or seems difficult to carry out under specific local conditions, should not hesitate to write for fuller information or advice.

* One fathom equals six feet.

Literacy Survey in Melanesia

Dr. K. Neijs, Literacy Adviser to the Commission, visted New Caledonia, the New Hebrides and the British Solomon Islands from early April to late July, to survey forms and methods of literacy teaching being used and to investigate practical needs in teaching and opportunities for expanding work in these areas of Melanesia.

One particular problem Dr. Neijs observed was the need for suitable teaching materials in the re-education of adults who had to a certain extent lost their reading and writing skills, although these had been quite well developed during their attendance at school. He was able to assist in the preparation of aids of this kind, based on recent experience elsewhere, as well as to help in drawing up suitable teaching materials for use in the schools themselves.

Roads, Rice and Rural Progress . . .

A view of Amele village, in the Madang District.

IN the Madang District on the north coast of New Guinea the pattern of development is becoming clear: roads, rice and rural progress are the key themes at the present time.

Faced with the demand of the people for a greater share in the modern world and the need to take positive steps to develop the resources of the territory, the Government is attempting an advance on all fronts—education, health, agriculture and commerce. In the Madang District, particularly good progress is being made in opening up the country by means of roads, in building up a cash economy based mainly in the first instance upon rice, and in setting up rural progress societies as a means by which primitive people may run their business affairs.

Roads are the first essential—for immigrant and native enterprise alike. As the United Nations mission which visited the territory in 1950 remarked, it is impossible to "conceive of any permanent or steady progress, economic and social as well as political, if the various centres and the different areas of the Territory are not linked together and if a system of main roads with which local communications could be gradually connected, does not break the isolation of the inland communities, groups and villages."

Rice, though highly suitable for village cultivation, is imported in large quantities for consumption in the territory. It has therefore been given priority as an annual crop. Copra is still by far the largest export from the territory and, to reduce this dependence on the coconut, encouragement is being given to the growing of other permanent crops, such as cocoa and coffee. The extension of rice growing is part of a broad programme of diversifying the production of cash crops.

Rural progress societies provide a training ground for agricultural production. They are sponsored by the agricultural department for native producer groups where the educational standards are not, as yet, generally suited to the organization of formal co-operative societies, to guide and stimulate production up to the stage where the economic marketing of produce becomes possible. Once this stage is reached, rural progress societies are re-organized as embryonic co-operative societies, that is to say, they become native societies registered under the Native Economic Development Ordinance 1952. Such rural progress societies vary fairly widely in mode in operation, and depend heavily on the guidance of European officers.

Gulu of Amele

A good place to see economic advance based on the pattern of rice, roads and rural progress is at Amele, about 20 miles along the inland road from Madang, where a society has been milling rice since 1951.

The leading figure at Amele is Gulu, the paramount *luluai*, a man to whom much credit is due.

Since the war several native leaders have stood out from their fellows in New Guinea and the Government has been willing to share the burdens of administration with them. Some have lost their balance and abused the power placed in their hands. Such was Yali of Saidor in the Madang District. Yali had been to Darwin during the war and thought he had found all the white man's answers. The Government at first tried to use his high standing with the people in the manner of indirect rule, but his demands for immediate services from the villagers in return for future blessings got out of control. In due course a series of crimes brought him and his leading courtiers by proper legal process to gaol.

Gulu of Amele is a man of a different stamp. His motive seems to be the simple one of wanting to help his people make progress, and he thinks that to do this he needs the guidance of Europeans. Gulu has been seeking to advance the welfare of his people since his first contact with Europeans in the time of the German administration. He has co-operated actively with the Lutheran mission and the Government and is held in high regard by both. For some years he has been sending his own sons and other selected youths to the mission for training in mechanical skills and clerical work.

Largely owing to Gulu, rice production became firmly established in the Amele area after the war. He persuaded the people of his own and neighbouring villages to build up their cash crops and to give their labour freely to keep the road open to Madang so that their products could be traded for the tools needed to make hand tillage easier and the stores needed to make village life more attractive.

The Department of Agriculture, Stock, and Fisheries seized upon the opportunity to increase rice production, and readily agreed to meet a request to install a power mill for hulling rice at Amele. The villagers made a large building to house the machinery together with store rooms and quarters for operating staff. The need for the proper control and finance of the scheme led to the formation of a rural progress society, with Gulu as president. The society transacts its affairs in an open-sided building standing beside the mill house.

The example of Amele has been followed in ever-widening areas on the Madang District mainland. Fifteen societies have been formed, the number of villages in a society ranging from 5 to 34. Where there are coconut groves the marketing of copra is one of their functions; one society has acquired a large fishing net for community use; two have trade stores and one runs a hire service with a motor truck. However,

. . . . . in the Madang District of New Guinea

By R. N. HANCOCK*

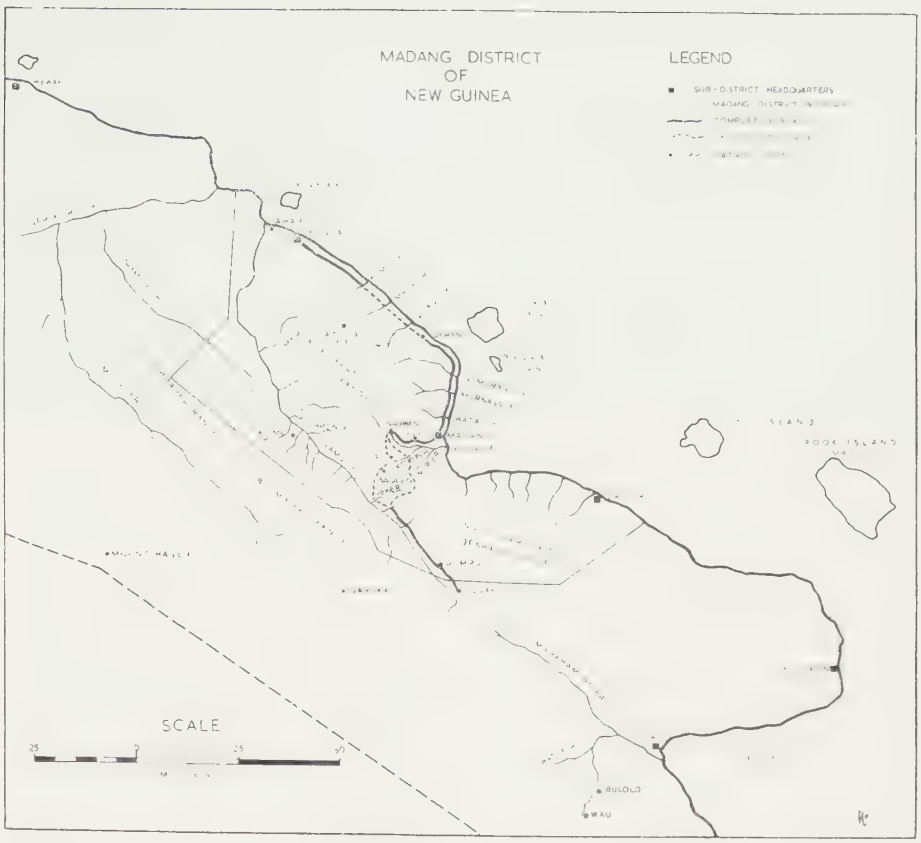
the desire to operate a rice mill has been the most common reason for setting up a rural progress society.

An interesting feature of each rural progress society is the large communal garden in the vicinity of the mill house. Here the main crops are sweet potatoes, rice and peanuts. The work is carried out by teams drawn from the villages which comprise the society, and the cash return from the produce goes to the common society fund until the society is solvent.

In the early days of the rural progress movement this communal gardening activity was watched closely. An official statement in 1951 remarked of the Amele and other similar projects that "there are, as yet, few which have developed far beyond the stage when the major emphasis is on economic development, but early indications are that interesting lessons can be gained from a study of the societies' present tendencies in the direction of one or other forms of economic enterprise, i.e., communal or individualistic peasant farming."

Some observers have considered collective schemes to be generally unsuitable for native agriculture, that is, for planting, tilling and harvesting crops. These activities are distinguished from a hunt, a fishing expedition or a trading voyage which may be undertaken on a communal basis. The communal operation of a rice mill or a trade store, the purchase of a truck or a launch and the various other activities of rural progress and co-operative societies are regarded as essentially different from agriculture. Agricultural production on a communal basis is thought necessarily to involve communal land ownership which is held to be neither practicable nor desirable. Thus James McCauley in *South Pacific*, July, 1953: "In the initial stage of group enthusiasm and goodwill, while the communal rice-field remains something exceptional and marginal, yielding only a small cash return, individuals are content to lend their land to the Rural Progress Society: but this will not do in the long run."

Experience in the Madang District does not lend support to this view. The purpose of the communal garden is to have a convenient centre where the members of a rural progress society can be introduced to new crops. In the Amele area sufficient progress has now been made in teaching rice and peanut growing and crop rotation for the emphasis to be placed on extending the cultivation of these crops in family plots in the component villages. The communal garden can now be used to demonstrate the cultivation of cocoa, together with the necessary shade crops. Other rural progress societies are likely to develop in a similar way: after rice and other new annuals have been firmly established in the area, the communal garden will be planted in a permanent crop.



The people have shown every sign of being well content with this system of communal gardens, and it would appear that where the necessary incentive exists they are just as ready to adopt collective methods for cultivating as for processing and marketing their crops. An incentive which is likely to be increasingly important in the future is the desire to use mechanical equipment for ploughing, planting and harvesting. The Amele society decided early in 1954 to order a Ferguson tractor, together with trailer, disc plough, hiller, and seed drill. This equipment will be used to work any suitable land in the society's area, no matter whether controlled by the society as a whole, a village belonging to the society, or an individual or group within a village.

Rice

From the early days of European settlement, the New Guinea people have acquired a taste for rice and they are very willing to learn how to cultivate it. The market price of 7-1/4d. per lb (December 1953) is also a significant incentive to the villager. The advantages of rice over indigenous crops are its keeping qualities, its nutritional content, its small bulk making for ease of transport and the short time needed to cook it. Notwithstanding the fertility of the soil, a dry period brings near-famine conditions in many parts which the introduction of rice and other cereals is now overcoming.

For the most part the Madang area is undulating with some river flats and two fertile valleys, the Gogol and the Ramu. Although long-term planning does not exclude the possibility of flooded rice culture in suitable areas, only simple dry land methods of cultivation are practised at present.

In the Madang District the development of rice production is the responsibility of the District Agricultural Officer, Mr. J. R. Vicary. Since the war a number of varieties of rice have been introduced and trials have been conducted by Mr. Vicary at the agricultural station not far from the Madang township. The four most suitable varieties have been found to be Madang (a selection from the pre-war introductions), Short Gopher, Long Gopher and Borneo. These are being grown at the station for seed-distribution.

Little trouble has been experienced with pests and diseases. The rice finch causes some damage in the dry season. *Helminthosporium* spp., *Ramularia* spp., *Entyloma orizae*, and a rice stem borer have been noted, none of them serious. Most concern has been caused by *Lepto-*

* Mr. R. N. Hancock is an officer on the staff of the South Pacific Commission who has visited Papua and New Guinea on several occasions. Editor.

Left: A road-workers' camp on the road leading from Madang to the Highlands. Right: Building a small bridge near Madang. The main bearers are Kwila logs. The abutments have been reinforced with coral blocks which will be surfaced with cement.

corisa, a sap-sucking bug which attacks the heads in the milk stage, leaving dry, empty glumes.

The introduction of modern methods has been confined to the processing of the crop but in this field considerable progress has been made. The first mill began operating at Amele in January, 1951. Since that date ten other rural progress societies have acquired mills through the agency of the agriculture department. A variety of makes of diesel engine are used for power but the mills are either Ancomill or Planters (No. 8 or No. 3). A thresher and a grader of Grantex make have been installed at Amele and at Foran, and two mills have a Robinson Little Wonder thresher and winnower. A set of platform scales is often included in the mill equipment. The equipment is housed in large buildings made of local materials and receives enthusiastic care and attention. Central rice hulling facilities are provided at the Madang agricultural station to hull rice from societies and plantations which do not have their own powered mill.

In 1952 rice growing in the Madang District was encouraged by the preparation of a plan for a big drive to reduce the territory's dependence on imported rice. Papua and New Guinea imports about 12,000 tons of rice annually which, with the price now about £A.100 per ton, is a significant item in the balance of trade. It was estimated that the 135,000 natives of the Madang and Sepik Districts could achieve an annual production of over 4,000 tons. About 1,700 tons would be consumed in the villages; the remainder would be available for sale to deficit districts. It was thought that if a large staff of trained agricultural officers could be recruited, housed and equipped, this target could be reached in five years. In 1953 more than 300 villages, comprising about 25,000 natives, were brought under the Madang and Sepik projects and it is planned to include an additional 112 villages in 1954. In 1953 these natives produced 450 tons of milled rice. The estimated production for 1954 is 815 tons. In the same areas in 1951, the total production was less than 10 tons.

Rural Progress Societies

The organizing of rural progress societies has been the work of Mr. Vicary and two other agricultural extension officers, one posted at Madang itself and the other at Bogis, northwest along the coast from Madang. Officers of the Department of District Services and Native Affairs have assisted in the work and the society at the other coastal centre, Saidor, has been under the supervision of the Assistant District Officer there.

The business operations of a society are the collection of funds for the purchase of capital equipment, the employment of permanent staff, the weighing in of crops and their processing and marketing. At every stage assistance is given by government officers but as far as possible it is in the form of advice, the actual decisions being taken by the office-bearers of the society.

There is little difficulty in raising the capital for the rural progress societies. Generally it is subscribed from money gained formerly as war damage compensation or in payment for community labour and held in village account books. In a few cases individual subscriptions have been collected. The agriculture department may extend credit to a society by providing equipment before society funds have risen to the total needed to purchase it.

Official summaries of the affairs of the original Amele society and the more recently formed Uligan society may be recorded as examples:

AMELE RURAL PROGRESS SOCIETY

Number of villages, 34

Kelly & Lewis Diesel Engine, Ancomill Rice Mill	*£600*	*0*	*0*
*Grantex Thresher (to be paid to D.A.S.F.)**	*125*	*0*	*0*
Grantex Grader (on loan by D.A.S.F.)			
Set Platform Scales	*60*	*0*	*0*
Mill House. Estimated at	*400*	*0*	*0*
Credit Balance of R.P.S.	*1,015*	*15*	*4*
Total Amount paid mainly to producers since 21st August, 1952	*2,738*	*18*	*8*
Trade Store Building	*200*	*0*	*0*
Stock at 30th November, 1953	*230*	*0*	*0*
Trade Store Credit Balance	*80*	*13*	*0*

ULIGAN RURAL PROGRESS SOCIETY

Number of villages subscribing, 20.
Number of subscribers, 605.

Amount Subscribed	*£873*	*3*	*0*
Credit Balance	*356*	*3*	*0*
Russel Newbery Diesel Engine	*292*	*0*	*0*
No. 7 Planters Mill	*87*	*1*	*3*
Mill House & Store. Estimated at	*200*	*0*	*0*

Department of Agriculture, Stock and Fisheries

The societies are making good profits. Mr. Vicary expects that in 1954 the Amele society will repay all initial subscriptions together with a dividend which may be 200%. He will then propose the issue of £1 shares up to £1,500 to pay for the tractor and agricultural implements which the society has decided to buy.

The simplest accounting methods are used in connection with affairs of the rural progress societies, the important principle being that all personal subscriptions are kept carefully recorded so that they can be refunded whenever necessary or desirable and that all personally produced crops are paid for either in cash or in kind. The societies frequently mill rice for both members and non-

Left: A view of the communal garden of the Amele Rural Progress Society in the Madang District. Rice can be seen in the foreground and left centre, sweet potatoes on the right. Right: The rice mill run by the Amele Rural Progress Society in the Madang District.

members, raising a charge for this service by withholding a determined proportion of the milled produce which is then marketed and the funds credited to the society account. Similar arrangements are made for the marketing of peanuts and other produce by the societies and have the benefit of enabling the producers to obtain an immediate return in the form of cash or food. These arrangements suit the present situation where the general educational standard, particularly of those men with sufficient prestige to have executive functions, is low. As the educational standard rises, and determined efforts are being made to improve this, particularly among the members of the societies, more normal types of business organizations will be developed. As soon as the Department of Agriculture, Stock and Fisheries considers the societies are capable of earning continuous profits and request the change, the existing societies will be converted into properly organized co-operatives.

Roads

The key to the problem of raising substantially the output of rice and other cash crops is the building of a road network in the district. In this way the people of the hinterland will be brought under the influence of the agricultural extension service and through means of access to markets will have the incentive to produce crops for sale. At the same time unused land will be opened up to European enterprise and production on a large scale with a full range of mechanical aids can begin.

New Guinea presents all the difficulties of terrain which an engineer would hope to avoid in road building—precipitous slopes, dense jungle, deluging rain, and swift-flooding rivers. This has not prevented the main effort being directed by amateurs—the officers of the Department of District Services and Native Affairs. Unhampered by prejudices acquired from training under metropolitan conditions but schooled in the problems of the local environment, they are well equipped to find the unorthodox solutions which alone will overcome the difficulties of road-making in the territory.

In the Madang District the main objectives are a 130-mile road inland from Madang to Gusap and a coastal road north to Awar, a distance of 150 miles. The Gusap road will open up the Gogol and Upper Ramu Valleys and then rise up to join the recently-opened route in the highlands between Gusap and Mt. Hagen. The other road will link up the old-established missions and plantations along the coast and provide the outlet for feeder roads from the populous hinterland.

The roads are being built by hand, the bulldozers of the war days having all gone south to meet Australia's pressing needs. The Department of District Services at Madang manages to keep three aging trucks on the road and hires another from time to time. The vehicles carry the surfacing rocks and gravel from quarries or river-beds to the road site, and bring forward the cement and heavy *kwila* logs for the culverts. At the same time they carry the road parties to their work, saving time each day and cutting down the number of road camps which have to be built. The essential items of equipment are the axe and the shovel and it must be said that even these have not always been in good supply.

A European roadmaster, who belongs to the works branch of the Administration, supervises the making of the coastal road, while on the inland route there are two patrol officers who add road-building to their other duties. These officers are assisted by native police constables who are seconded to road building work as supervisory foremen in charge of native working parties. The total number of workers engaged varies widely —according to the state of the district's finances. At the end of 1953 there were about 200 natives employed. Where native population is sufficient an important contribution is made by volunteer labour from the villages in the vicinity of the road. Planters and missionaries help where they can with equipment. The efforts of all are inspired and directed by the vigorous Assistant District Officer, Madang—Mr. T. W. Ellis.

Not all the construction is in virgin forest: many sections involve the clearing and repairing of old roads. The Madang-Awar road will incorporate parts of a pre-war track which was later used by the Japanese and then the Australian forces. In the Ramu Valley a section of road built by the Australian Army for the famous Shaggy Ridge action is being cleared, and it will be possible to recondition part of a Japanese road. For the rest, arduous patrols on foot must be made to select a route and then initial clearing must begin. More than once hidden difficulties have been revealed by the clearing and an alternative route has had to be surveyed.

Clearing is not a job that can be done once and for all. The road must be promptly formed and surfaced with stone or the undergrowth will come up in the rear of the clearing party and the work will have to start all over again. Another factor which adds to the task is that the jungle must be kept back from the sides of the road so that the sunshine can get in to dry out the road after rain. The roadside drains, too, cannot be skimped; they must be deep enough to carry off the deluges which make up an annual rainfall (at Madang township in 1951-52) of 128 inches.

Bridging presents formidable problems. On the north coast road the two major rivers to be crossed are the Murnass and the Sumarong. It is estimated that to bridge either of them at the mouth would cost £A.15,000. The inland route faces a big obstacle in the Gogol River. Old army pontoons will be put back into commission if possible. *kwila* timber is used to take the road over the smaller rivers and streams but in a few cases recourse has been had to Bailey steel bridging, salvaged from army dumps.

Through the effective use of local resources, both labour and materials, impressive results are being achieved. With the aid of a fraction of the equipment which an Australian civil engineer would regard as essential, the native people under the direction of their district officers are changing the whole aspect of the territory's present problem of communication, and a great opportunity is presented to make gains out of all proportion to the capital investment involved.

Mechanization

Mr. Ellis makes no secret of it in dealing with the village people that, even if the government helps them build roads, produce rice and put in permanent crops, the main effort must come from the people themselves. His constant theme, which is doubly effective in his masterly Pidgin English, is that the end of the time of fighting brought not a return to the good old days but the beginning of a time of hard work.

It is frequently stated that land and labour is not a problem in New Guinea; all that is needed is this or that other factor. This is the truth but not the whole truth. There is plenty of land but the bulk of it is precipitous, inaccessible or heavily timbered, often all three. To bring it under cultivation requires the massive application of capital or manpower or both.

Labour, too, is plentiful to the extent that there are large numbers ready to take employment. But the labourers cannot be in two places at once nor can they do two jobs at once. If too many able-bodied men are away working elsewhere, village production will suffer. Similarly, if too great an effort is put into new crops, the production of old ones or the maintenance of village buildings and tracks must be neglected. The only way of avoiding this is for the efficiency of the individual worker to be improved—through education in better techniques and help from mechanical or animal power.

Undoubtedly progress can be made by "taking up the slack." In the Madang District the propaganda campaign which is being conducted by government officers against the local rather dilatory attitude to work and in favour of sustained application to the job is achieving good results. Nevertheless, a significant change cannot be expected in the economic status of a people while retaining hand labour alone. If the profit from cash crops—either annual or permanent—is to raise appreciably the levels of living of the indigenous producers, greater use will have to be made of animal power and, above all, of mechanical power.

In this process the rural progress societies have an essential part to play. It is true that individual management of land is developing in some areas, and in some cases the difficulty of introducing machinery may be overcome by organizing production along western capitalistic lines. In the Madang District, for instance, there is Irakau of Manam Island, who has recently added 6,000 young coconuts to his plantations, cultivates more than 20 acres of rice as well as native gardens, and in 1952 employed over 50 workers. However, for the bulk of the people of New Guinea mechanization will mean some adaptation of the existing system of family production, and the rural progress society, an institution which has been tried and proved successful, will undoubtedly provide the solution to the problem in many areas.

Writing in 1952, James McCauley argued that the "effect of introducing a high level of mechanization is that the family loses its role in production. This is not so in most forms of Western agriculture, where a family may possess the land, capital and skill needed to run an efficient farm, but it must be so in New Guinea, where the individual native family is not equipped to handle the problem. . . . The inference to be drawn is that highly mechanizable annual crops are of doubtful suitability for native agriculture." This is surely a gloomy view. It is difficult to see why large-scale rice production should be any more damaging to the family as a social unit than any other form of communal activity, and equally difficult to see why mechanized production should not be quite suitable to New Guinea natives appropriately organized on a collective basis.

In this light, it will be seen that Gulu and his fellow members of the Amele Rural Progress Society have reached a decision of some importance in ordering a tractor and agricultural implements for use on their land. As, with the guidance of government officers, they devise a system for the management of this equipment, they will be setting a pattern for the mechanization of cultivation which will be worthy of study in the many areas which are at a similar stage of development.

DEVELOPMENT OF NETHERLANDS NEW GUINEA

THE Netherlands Cabinet Council resolved in 1951 to set up an interdepartmental committee to examine the development of Netherlands New Guinea to date, and to outline further development. Some findings of the committee's report are briefly reviewed below.

The report emphasizes that planning should take account of the development proceeding in the Australian part of the island and also of the way in which similar problems have been approached in African territories, and of the results obtained there.

The committee states that a serious obstacle is the very limited knowledge of the land and its people. Research in all fields is therefore initially required.

To promote development, the basic requirements are:

A well-established district administration;
reasonable connections and possibilities of transport;
education, including improvements of health and nutrition, schools, agricultural extension, etc.

Only on this basis can economic development be promoted along sound lines.

It is possible to draw up local development plans for those areas on which enough information is available, but an "overall" development plan must be limited to general terms, with stress on research.

The Committee showed considerable interest in the South Pacific Commission, including the First and Second South Pacific Conferences and the Commission's work programmes.

It was felt that community development projects should follow Commission recommendations. Development of co-operative organization is recommended "as far as possible with the assistance and advice of the South Pacific Commission."

For the investigation and solution of similar problems, closer collaboration with other territories in the South Pacific through the Commission is urged.

In the field of health, emphasis is on education and extension, using all possible means, and enlisting Commission assistance, with particular reference to visual aids.

The report refers to nearly all the projects in the Commission programme, including vocational training, visual education, South Pacific Literature Bureau, housing, leprosy, nutrition, fisheries, soils and land use, cash crops, subsistence economics and animal and plant pests and diseases.

The report concludes: "International collaboration should be sought in the first place through the South Pacific Commission as, for that matter, is already being done (Nimboran, leprosy research, population study South New Guinea, investigations into housing conditions)."

Following submission of the report, an Advisory Commission visited the territory in August and September, 1953, with a view to drawing up specific proposals for the economic development of Netherlands New Guinea, as mentioned in the January *Quarterly Bulletin*. The report of this second committee has not yet been received but, as soon as it is, an indication of its main findings will be given in the *Quarterly Bulletin*.

—*A.H.J.K.*

REFERENCE: *Toekomstige Ontwikkeling van Nieuw-Guinea* (Future Development of Netherlands New Guinea), Government Printing Office, The Hague, 1953 (2 vols.).

The following article, describing some of the quarantine measures taken at the Kila Animal Industry Centre and Quarantine Station near Port Moresby, is reprinted from the "Papua and New Guinea Villager" for January, 1954. As the "Villager" is published by the Department of Education, Port Moresby, this article is of interest not only as indicating some of the quarantine problems associated with livestock importation but also as illustrating the style used for native readers.

It relates particularly to the importation in 1953 by the Papua and New Guinea Administration, in conjunction with the Council for Scientific and Industrial Research Organization, of eight Sindi calves, ten Sahiwal calves and four water buffaloes from Pakistan, for cross-breeding and other experimental purposes. The animals were transported to the territory by air, special arrangements being made to cover their feeding, watering and exercising en route. On arrival they were placed in strict quarantine at the Kila Station. The extensive precautions taken there will be of interest in territories contemplating the improvement of their own livestock industries by making similar importations.

Spraying Zebu cattle at Kila.

Animal Quarantine At Kila

THIS is the story about the animal quarantine station at Kila near Port Moresby.

Why do we have these places called quarantine stations? These places are needed to protect animals from disease. One of the things the Department of Agriculture, Stock and Fisheries is trying to do is to give the territory good types of cattle; cattle that breed well, do not mind the heat, are as free as possible from disease and are good milkers and meat producers. To do that there is a great deal of work to be done, work that will take many years.

First the cattle have to be bought in some other country and brought to the territory. The cattle in quarantine at Kila Animal Quarantine Station consist of 18 Zebu and four milk buffaloes from Pakistan. At the station also are eight cattle, four goats, four sheep, four pigs and one horse. These animals were brought from Australia. These are all the animals at present at Kila, but they are very valuable animals. Before their quarantine time began they had cost more than £20,000.

Cattle in many parts of the world suffer from different diseases or sicknesses. These diseases must not be allowed to get into other countries. If they do, great damage can be done and thousands of cattle may die. The quarantine period for different diseases varies. Sometimes it is six weeks, or six months, sometimes more. That means that the animals must be quarantined or kept apart from other animals as soon as they reach their journey's end. A quarantine station is a very strict place. Listen to the story of a visit to the station.

On arrival at the Kila Animal Quarantine Station not very long ago I got a surprise. The surprise was caused by the fact that I had to drive my car into the station through a disinfectant bath about a foot deep. The station was enclosed by a ten-foot high double barbed-wire fence. Great lights round the fence are turned on as soon as it gets dark so that stray dogs, cats or wandering animals cannot get in. If they did, they might carry some disease inside with them, or catch a germ inside and infect territory animals outside the station. Four shoot-boys and two watch-dogs are on duty all the time to prevent this.

I had more surprises coming. The veterinary officer-in-charge took me into the yards where the cattle are situated. Before going in I had to remove my shoes and put on a large pair of rubber boots. Then I put over my clothes a large khaki overall. These articles have to be washed every day. That was not all. I saw another interesting thing. A shower bath is installed at the entrance. This is used by the staff at the beginning of the quarantine to wash off germs before and after entering the quarantine yards.

We were ready to enter the cattle yards. But surprises were still to come. The door was opened and I was told to step into another deep bath of disinfectant and walk through it for about ten feet before I stepped out the other end. I had not gone far before I noticed cement drains running through the yards. I saw that all these ran to a deep cesspit at one end of the station. On asking, I was told that all waste ran down to this pit; that the pit was regularly inspected and the water tested for foreign disease-carrying matter before it was allowed to run free outside the station. The last thing that I discovered was that all waste food, manure and rakings from the yard are burnt.

I will admit that I was amazed that so much strict care is taken of these animals. In one of the buildings of the animal yard there is a small laboratory. Here all veterinary tests are carried out. Sometimes the cattle have to receive injections. At other times their blood has to be examined or other tests carried out. I was told that the animals had to remain in quarantine for one year. In that time there are four very special tests they have to pass before they are considered free from all kinds of disease. One of the tests is made to find out if they may be carriers of certain diseases in their blood. These diseases are insect-carried diseases like malaria and others which are carried in our blood or the blood of animals.

This is the last test. Fourteen calves arrived in Port Moresby. They had all had their spleens removed. These young

Continued on page 33

* EDITORIAL NOTE: The Department of Territories, Canberra, has supplied the following later information:

The final test as described in the article has shown that the zebu cattle carry two disease organisms, **Anaplasma marginale** and a **Theileria** species.

Anaplasma marginale is already widespread in northern Australia and probably in the parts of Papua and New Guinea to which Queensland cattle have been introduced. Although the imported strain seems to be less virulent than the Australian strain, it is considered it would be bad to let it spread; for this reason, the stock will be kept and bred in an area yet to be decided in tick-free conditions which will prevent infection spreading even to their calves which may then be used in the breeding work planned.

The **Theileria** has not yet been definitely identified, but it is expected that it is one that occurs in Pakistan and not in Australia or Papua and New Guinea; the tick that transmits it does not occur, either. The measures taken against spread of the **Anaplasma** will also be effective against the **Theileria.**

The results of the tests indicate the importance of taking proper care in moving animals from one country to another; incidentally they show also what a pest cattle tick is in acting as agent in the spread of animal disease.

Breadfruit tree, variety "Mai," Gilbert Islands.

Pacific Subsistence Crops

BREADFRUIT

The third of a series of articles on subsistence food plants of the South Pacific*

Prepared by

EMILE MASSAL and JACQUES BARRAU
Executive Officer for Health Subsistence Agriculture Officer

AMONG the food crops of the South Pacific the most characteristic is certainly the breadfruit tree, of which the fruit and sometimes the seeds enter to a varying extent into the diet of Polynesian, Micronesian and Melanesian peoples.

In the minds of many Europeans the breadfruit tree is the symbol of abundance and easy living in the South Sea Islands, as they were once fondly imagined to be. This rather romantic fame, and above all the reputation made for the breadfruit by the first navigators, led some more realistically-minded planters in other parts of the world to try to secure for their slaves a tasty food to be won without effort. The numerous attempts made through the 18th century to introduce breadfruit into other tropical regions are thus explained. Among many others could be quoted the endeavour of the French voyager Sonnerat, who, returning from a journey in the Western Pacific, brought back breadfruit tree seedlings to the Island of Mauritius in 1772. Books and the cinema have popularised the odyssey of the "Bounty." The aim of Captain Bligh on this voyage in 1787 was, indeed, to go to Tahiti and bring back breadfruit seedlings for the British planters of Jamaica.

Known to botanists as *Artocarpus altilis*, Fosberg, the breadfruit tree belongs to the family Moraceae. Another species of the same family, *Broussonetia papyrifera*, L'Her., the paper mulberry, was well known to the Polynesians of old. Its bark—and indeed the bark of breadfruit trees also—was the raw material used to make "tapa," the Polynesian bark cloth.

Artocarpus altilis is a handsome tree from 35 to 40 feet high or even more. Its leaves, large, thick and rough, are most often lobate or incisate, sometimes entire (see diagram). Male and female flowers are grouped separately in catkins on the same tree. The fruits may be found at all stages of development on the same plant. They are ovoid, spherical or pear-shaped in form, described botanically as syncarps. The accompanying drawings obviate the need for a more complete botanical description. In territories where breadfruit has been grown for a long time, the fruits of many varieties are seedless. The breadfruit tree gives a white sticky latex which is still used in the native pharmacopoeia, and was used in the past as bird-lime and in the preparation of caulking pitch for canoes.

It seems that the species had its origin in Indonesia and perhaps also in New Guinea, where important natural stands are found. At present the breadfruit tree is found throughout the Pacific both on high islands and atolls, but its limit of occurrence does not appear to extend quite as far south as the Tropic of Capricorn. Indeed, in New Caledonia the breadfruit tree is really abundant only in the north-west of the island, where the climate is more truly tropical. In the western and southern parts of the island it is seldom seen, and produces only a few fruits of mediocre quality.

The climatic requirements of the breadfruit tree vary according to varieties: in Indonesia, some varieties are adapted to droughtless climates while others can withstand six months of dry weather. The average temperature suitable for breadfruit is probably over 71°F., which would explain the above-mentioned limitations of its zone of occurrence.

Artocarpus altilis thrives on alluvial and coastal soils. It can also grow and produce on the coral soils of atolls. However, on atolls in the dry equatorial belt, the southern Gilbert Islands for instance, the breadfruit trees are sometimes killed by the periodical droughts affecting these regions. Some varieties of *Artocarpus altilis* grown on the atolls are said to tolerate salinity; this is the case of the "Maitarika" variety of the Gilbert Islands. The breadfruit tree is affected by the wind which can easily break its branches and cause the fall of many flowers and young fruit.

The time of harvest differs in the various territories. In Ponape, Caroline Islands, it lasts from May to September and the same is true of the Gilbert Islands, where the peak of the season is from May to July, while a less abundant production takes place until the end of the year. In the Society Islands, the peak of the harvest occurs from November to April with a secondary one in July/August. However, the cultivation of more or less late varieties makes it possible to gather a few fruits all the year round. In the New Hebrides, there are also two ripening seasons, one in the southern summer, the other in July/August.

Although sometimes propagated by seeds, the breadfruit tree is more often planted as a sucker or root cutting (this is obviously always the case for seedless varieties). Except for protection by staking or enclosure sometimes given to young plants after setting out, the breadfruit tree requires no particular care. In Tahiti the main branches are sometimes severely pruned in order to gain easier access to the fruit.

The tree starts bearing after five or six years. Under good conditions of soil and climate it can produce for 50 years. An adult tree yields from 50 to 150 fruits per year representing a total weight of 110 to 550 pounds, or from 25,000 to 120,000 calories nett per tree per year, according to locality, age of the tree and variety. Varieties are numerous wherever breadfruit has been established for a very long time; in Ponape the local inhabitants are said to distinguish about 50; approximately 30 are recognized in Tahiti. In some territories where breadfruit was the staple food, the plant was the subject of effective selection through

* Earlier articles have appeared on **Taro** (October, 1953, issue) and **Yams** (July, 1954). Editor.

the centuries; nowadays most of the cultivated varieties are seedless and each is adapted to a given environment.

While breadfruit is used throughout the Pacific for human consumption, it is far from playing everywhere the same part in the diet. Among the island groups now included in French Oceania, breadfruit was the staple food in the Marquesas where it is still much used; in Tahiti it shared this distinction with the banana; in the Gambier and Austral Islands, on the contrary, it was used only as a supplement for taro, which was the basic foodstuff. In New Guinea only the seeds are used, either roasted or boiled.

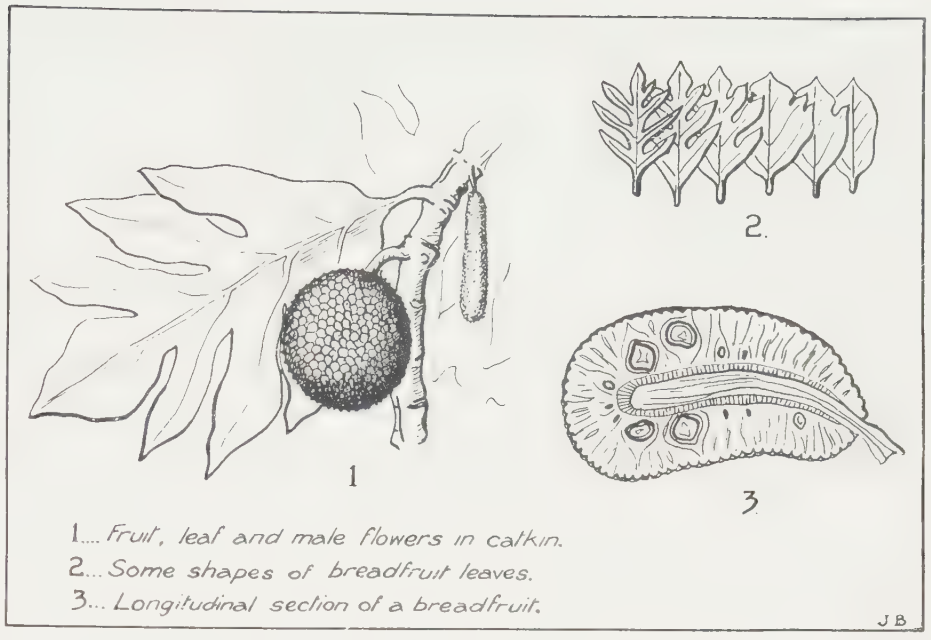
A review of various food composition tables gives the following average composition of edible portion:

Water	g. 70
Calories	105
Proteins	g. 1.6
Fats	g. 0.3
Carbohydrates	g. 25
Ash	g. 1.2
Calcium	mg. 33
Phosphorus	mg. 32
Iron	mg. 1.1
Vitamin A	iu. 40
Thiamin	mg. 0.15
Riboflavin	mg. 0.03
Niacin	mg. 0.9
Ascorbic acid	mg. 23

The following table prepared by Miss Carey D. Miller allows a comparison to be made between the quantities of the vitamins thiamin. riboflavin and niacin and of calcium contained in the weight of various foods necessary to produce 100 calories.

Breadfruit is a satisfactory source of calories; the protein content is low and the amino-acid components are not known; the fat content is negligible. Thiamin content is sufficient and is in balance with the calorific value. With the exception of Vitamin A, the other vitamins and mineral salts exist in appreciable quantities. However, like all unconcentrated foods, breadfruit would have to be consumed in great quantities in order to bring enough nutrients in the ration. Even then, its low content of protein fat and Vitamin A makes it imperative to supplement it with foods rich in these elements such as meat, fish, legumes, fats and greens.

The seasonal nature of the production, resulting at times in supplies being in excess of consumption, has led to the development of preservation practices such as the following:



1.... Fruit, leaf and male flowers in catkin.
2... Some shapes of breadfruit leaves.
3... Longitudinal section of a breadfruit.

JB

In one method the fruit is cooked, then reduced to a paste which is dried in the sun in thin layers and wrapped in plaited leaves. The product keeps fairly well for some time, and is soaked in water before use. It is a concentrate of the nutritive elements.

The processes of preservation by fermentation are more curious. In the simplest practice a great quantity of fruit is cooked in a large native oven and left there to ferment; the product is taken out according to needs through an opening in the side of the oven. This method allows preservation for only a few weeks.

The process once widely used in the Marquesas made for longer preservation. The ripe fruit is peeled, washed and split in two. The core is thrown away and the fruit placed in stone pits lined with the leaves of *Cordyline terminalis*, a kind of cabbage tree called "ti" by the Polynesians. Layers of fresh fruit are alternated with layers of old fermented preparation in order to facilitate fermentation and to obtain a more homogeneous product. When the pit is full it is covered with leaves, rocks and earth. At the next harvest a pit which had not been completely emptied would sometimes be simply filled up again.

Fermentation causes an intense acidification which insures the conservation of the paste for months and even years.

The preparation of these fermented pastes known as "ma" in the Marquesas, "mahi" in Tahiti, "maratan" in Ponape and "namandai" in New Hebrides was a common practice in many South Pacific territories, and still persists in some places. At Melsissi in Pentecost Island, New Hebrides, the natives wrap breadfruit in leaves and the bundles are placed in heaps of stones built on the beaches and regularly covered at high tide. The alternating effects of the sun's warmth and the immersion in salt water promote a fermentation similar to that which occurs in the pits of the Marquesas.

Cooking recipes for breadfruit are numerous, but many differ only in some minute details.

Fresh fruit may be baked in the native oven or roasted on hot coals or hot stones. The rind and the core are taken off after cooking. Boiling peeled and cut fruit in water is quicker, although some nutrients (vitamins and mineral salts) are partly lost when the cooking water is thrown away. When cooked in one of these ways breadfruit is eaten with sauces, mostly made from coconut. Fresh breadfruit cooked and whipped with coconut cream is a delicious dish, to European taste as well.

In some recipes coconut cream or ripe coconut meat may be added to the raw fruit. The dish is wrapped in leaves and cooked in a native oven or on hot stones.

Other more involved preparations are worth mentioning briefly. In one of these, fresh fruits, cooked and peeled, are pounded and mixed with bananas or other cooked fruit; the whole is seasoned with lemon juice. The result is a slightly sour mash, the sharp flavour of which is rather unpleasant to the European palate

To prepare the Tahitian "poe uru," breadfruit is cooked in the native oven,

	Weight Giving 100 Calories	Thiamin	Riboflavin	Niacin	Calcium
	gm.	mcg.(1)	mcg.	mcg.	mg.
White flour	28	20	8	226	5.4
White rice	28	25	8	560	2.5
White rice, washed and cooked	28	5	—	390	2.5
Sweet potato	80	80	48	559	24.0
Breadfruit	70	96	59	720	14.7
Taro	70	149	25	424	16.0

(1) Micrograms.

Breadfruit seeds for sale at a native market at Lae, New Guinea.

then peeled and reduced to a paste to which is added a mixture of cassava starch and water. The whole is sweetened and seasoned with lemon juice. The paste obtained has a gelatinous consistency. It is divided into portions, wrapped in banana leaves and cooked again in the oven. "Poe" is consumed with sweetened coconut cream.

The male inflorescence which has fallen spontaneously from the tree and is of a yellowish colour with brown stripes is used in the preparation of a delicious sweet. After boiling and peeling it is cooked for two or three hours in a vanilla-flavoured sugar syrup until it becomes translucent. The little cylinder which remains of the catkin is then rolled in powdered sugar and completely dried in the sun. The sweets thus obtained resemble the European candied fruit.

The preparation for consumption of the fermented product taken from the storage pits is done in various ways. To obtain their "popoi" the Marquesas Islanders tamp the paste "ma" into oblong packages wrapped in *Cordyline terminalis* leaves and these bundles are cooked in the native oven. At the same time whole fresh fruits have been cooked and peeled. The two are mixed by pounding and adding water occasionally until a paste, the colour of coffee to which a liberal amount of milk has been added, has been obtained. This "popoi" was the staple food of the Marquesas islanders. Sometimes the paste taken from the pits is merely mixed with variable proportions of coconut cream. Marquesian "ma" has an unpleasant fecal odour. For European tastes it can be mixed, after cooking and whipping, with some coconut cream, or, even better, with some sweetened condensed milk, and spread on a slice of bread. This dessert, according to Dr. L. Rollin, is worth any cheese.

Breadfruit was once used to feed young children; it was cooked in the oven or roasted and given in small chunks or in small pieces rolled in the fingers. The Marquesas islanders used to give newly-weaned children a very ripe fruit pounded with coconut cream.

The Europeans cut the fresh fruit into thin slices which, after frying, are somewhat like potato.

In closing this brief review of the breadfruit tree it should be mentioned that while the food value of its fruit is not particularly high, it compares favourably with that of the other fruits, tubers and roots which are the staple foods of South Pacific people. The preservation techniques and the complicated preparations once used are being gradually abandoned. It is nevertheless a fact that many islanders remain quite attached to the breadfruit tree, for instance in Tahiti, where its origin is the subject of a beautiful legend. Breadfruit is still eagerly sought after. Together with the necessary supplements—fish, coconut and greens—it constitutes, indeed, a food which should be preferred to white bread and polished white rice.

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Rooting Cacao Cuttings

AT the Tropical Experiment Station, Pichilingue, Ecuador, F. L. O'Rourke has tested several combinations of phytohormones and fungicides for the rooting of cacao cuttings, aiming at the same time to reduce losses due to disease in the propagators.

Comparisons of different types and concentrations of hormones, and the combination of hormones plus fungicides, and of hormone plus arginine and/or adenine on rooting cacao cuttings, have been also made at the Inter-American Cacao Centre in Costa Rica by P. L. T. Alvim and Ovidio Duarte. Liquid (quick-dip method) and powder mixtures have been tested. The best mixtures are: 8,000 ppm. of indole-butyric acid in the powder mixture of talc and Phygon XL (3 : 1) or talc and Orthocide 50 (3 : 1). These mixtures gave highly significant increases in the percentage of rooted cuttings as compared with any of the treatments previously recommended. This is apparently due to control of diseases at the base of the cuttings. These mixtures are relatively easy to prepare and are much easier to handle than hormones in liquid form. No indication was found that arginine or adenine affected rooting of cacao cuttings, or that mixtures of indole-butyric acid and other hormones (naphthalene-acetic acid and naphthalene-acetamine) are better than straight indole-butyric acid at 7,000 or 8,000 ppm.

—From "*Cacao,*" Inter-American Cacao Center, March-April 1954, Vol. 3, No. 2, Turrialba, Costa Rica.

Cacao Pod Meal For Cows

TWO experiments in which dried cacao pod meal was used as a concentrate in rations for dairy cows are reported in the January-March issue of *Turrialba,* quarterly periodical of the Inter-American Institute of Agricultural Sciences, Costa Rica.

In the first experiment, the cacao pod meal was artificially dried. Its feeding value was compared with dehydrated cassava meal and recently harvested ground corn with 7.5% protein content. Each concentrate tested represented 50% of the ration. Total milk production under the corn ration gave 2,295.8 kilograms, under cassava meal 2,244.3 kilograms, and under cacao pod meal 2,462.0 kilograms. These figures are for 12 cows during 28 days. Differences are highly significant.

In the second experiment, the cacao pods were sun dried. The cacao pod meal had superior feeding value to corn with 9% protein content, although the differences were not statistically significant. Milk production per cow during 63 days gave 523 kilograms under cacao pod meal and 500 under corn.

Research School of Pacific Studies

The Research School of Pacific Studies is one of the four corner-stones of the Australian National University, which was brought into existence by an Act of the Commonwealth Parliament in August, 1947.

By ANN COUSINS*

THE Act, which marked the entry of the Commonwealth Government into the academic world of Australia at a particularly high level, was designed to fill a gap in the existing academic life of the country by providing at Canberra a national centre for advanced post-graduate research and study in subjects of general interest and of national importance.

The Research School of Pacific Studies, unlike the three other Schools—Medicine, Physical Sciences and Social Sciences—is meant to combine general fundamental research with regional interests, directing most of its researches towards the problems of an area of special significance for Australia. It has five departments — Anthropology and Sociology, Geography, International Relations, Far Eastern History, and Pacific History. The inclusion of a Department of Indian Studies is still in the planning stage.

The foundation of the School of Pacific Studies and the basis for its early research were laid in 1949, though the academic staff did not take up their duties in Canberra until 1950-51. In 1951 Professor Raymond Firth, Professor of Anthropology at the London School of Economics, spent a short period in Canberra acting as the temporary Director of the School.

Personnel of the School

In 1950, four Professors were appointed to take charge of the Departments; Professor S. F. Nadel as head of the Department of Anthropology and Sociology, Professor J. W. Davidson in charge of Pacific History, Professor O. H. K. Spate, Geography, and Professor W. R. Crocker as head of the Department of International Relations. With Professor Firth's departure in 1952, Professor Nadel was appointed Dean of the School.

To these have been added Dr. W. E. H. Stanner, Reader in Comparative Social Institutions in the Department of Anthropology, C. P. Fitzgerald, formerly Reader and now Professor of Far Eastern History, and Lord Lindsay of Birker, Senior Fellow in International Relations. Lord Lindsay has been acting as head of the Department of International Relations since May, 1952, when Professor Crocker was granted leave of absence to take up the position of Australian High Commissioner in India. Eight Research Fellows and four Research Assistants were also attached to the School during 1953.

The training of post-graduate research students, the majority of whom also hold National University scholarships, is a further part of the School's activities, and more than ten such scholars were working at Canberra for a National University degree in 1953. The wide variety of overseas universities from which these students are drawn demonstrates, even at this early stage, the international reputation the School is earning.

The School's Research Work

Within the Pacific, the research activities of the School are directed broadly to three areas, firstly to the territories which Australia controls and the other non-self-governing territories of the Pacific, secondly to the Asiatic Pacific countries of China, Japan, South-East Asia and India and finally to Australia itself.

Within these areas, the aim of all research is to produce not mere descriptive material but to study the basic social and political processes at work. Investigations are directed towards providing more precise knowledge of the problems of the area, theoretical as well as practical, and to some extent towards devising solutions of the latter. Field study is regarded as an important part of the research in all branches of the School, and the results of such experience, particularly in the Pacific Islands, are a valuable contribution to the accumulating knowledge of island social problems.

Work in the Pacific Islands is largely in the hands of the Departments of Anthropology and Pacific History. The Department of Anthropology has to date been chiefly concerned with problems of social organization and control, and of change and contact in the Territory of New Guinea. Work in the field is being carried out in the central highlands of New Guinea, in New Ireland and on the north-east coast of New Guinea. In the last area special attention was paid to an important religious contact phenomenon, the "Cargo Cult" of New Guinea. Dr. C. S. Belshaw, until recently a Research Fellow of the Department, was studying modern economic change in New Guinea while other research workers investigated other cultural changes in the New Hebrides

One of the earliest researches of the Department was a socio-anthropological study of an Indian community in Fiji, conducted by a Scholar, Dr. A. Mayer, in 1949. An investigation allied with the Department's work, though not part of its research programme, was Professor Firth's return visit to Tikopia, the area of his first field work, carried out during his period with the Pacific School.

The Department of Pacific History is aiming to cover the history of the individual islands with the emphasis on the contact between political ideas and indigenous institutions. Among these studies are that of the evolution of political institutions in Western Samoa, of a political history of Tonga, with special reference to the development of the social services, and of administrative development in French Oceania. Work in New Guinea is at present concerned with research into the evolution of administrative control in the Central Highlands, and into the administrative history of Netherlands New Guinea. Miss Ethel Drus, Lecturer in History at Birkbeck College, London, is at present in Suva studying the formulation of policy in Fiji during the years 1874-1916 under a Research Fellowship from the Department.

Research in Pacific Island Geography is as yet mainly in the planning stage. It is meant to include, probably in 1954-55, an investigation of the European plantations in the Lower Markham Valley, New Guinea, and of the agricultural geography of the Gazelle Peninsula.

Pacific Studies Conference

In August, 1951, a Seminar Conference was arranged at the School to draw together a group of social scientists working on Pacific problems. The Conference included a distinguished representation from overseas among whom were Dr. Margaret Mead, Professor E. Beaglehole, M. Jean Guiart of the *Institut Français d'Océanie*, and Mr. L. G. Hudson from the Pacific Science Council Secretariat, in addition to Australian social scientists.

Topics for discussion were confined to social processes in the Pacific with the object of defining as closely as possible the nature of the problems and the forces at work, and of formulating hypotheses for future research. As such the Conference formed a fitting background for the School's own research programme.

Closest Relations with Commission

From the outset the Research School has shared the closest relations with the South Pacific Commission.

The opportunities for two bodies working in related fields to co-operate with

* This article was prepared under the guidance of the Commission's Social Development Section by Ann Cousins, who was formerly with the Royal Institute of International Affairs in London and has herself been engaged on Pacific historical research. Editor.

mutual profit on matters of material, facilities and published results are, in this instance, wide; and the Commission has been able to make available to the School's research workers documentary material from its technical libraries as well as information collected by its specialist officers.

The research work undertaken by the School is, of course, of direct interest to the Commission; and the present investigations in New Guinea on culture contact and the relationship of the administration to the native people, and the work on social services in Tonga are of particular relevance. It is hoped that the results of such research will later be made available to the interested territorial governments.

In addition to mutual assistance, an active working collaboration has been entered into by the Commission and the Research School in the participation of the School's research workers in Commission projects.

Thus Dr. C. S. Belshaw, who was until recently a member of the Department of Anthropology and Sociology, assisted in the Commission project on Industrial Development by providing a survey of recorded skills of potential commercial value in the Pacific Islands and a comparative analysis of the experience of industrialisation in tropical dependencies outside the Pacific.

The School is also assisting the Commission in its long-term project for the collection of information about native entrepreneurs in the Pacific. Work under this head, which is under the guidance of Dr. W. E. H. Stanner, is aimed at discovering a means of assisting the indigenous people to a larger participation in the commercial and industrial life of the area.

The close ties between the two organizations are well illustrated by the appointment, in March, 1953, of Dr. Stanner as Second Commissioner for Australia to the Commission, and the presence of Professor J. W. Davidson as an official observer for the University at the Second South Pacific Conference held in Noumea in April of the same year.

School's External Activities

In addition to its work with the South Pacific Commission, members of the Research School have been on occasion able to give direct assistance to the Western Pacific High Commission and to the Australian Government.

In Fiji, the Department of Pacific History and the High Commission have been sponsoring a joint undertaking for the classification and arrangement of the High Commission archives carried out during 1953-54 by Miss D. Crozier. This work is regarded as a trial project, which may well lead to similar projects in other territories with large collections of historically valuable records whose classification and preservation is of great importance.

Finally, the School's outside activities bring it into direct association with the other Universities of Australia, and a mutually beneficial co-operation is being established.

The Research School of Pacific Studies is thus an organization of a unique kind. Affording as it does a centre for intensive regional research and theoretical studies, its work is at the same time closely identified with the initiative for assessing or at least indirectly promoting the development of the people of the area with which it is concerned.

The Preservation of Thatch Materials

CONSIDERABLE interest has been shown lately in the Pacific in methods of prolonging the life of thatch materials. In the *Quarterly Bulletin* for October, 1953, the list of Technical Publications in Social Development referred to an article describing a treatment plant which had been developed in India (brief particulars of it are given below). Copies of the article have now been widely circulated in the Pacific. Further information on this process and the general research being undertaken at the Indian Forestry Research Institute and elsewhere is being sought and when available will be circulated by the Commission.

The Indian process, which is the most satisfactory so far developed, gives the thatch an expected life of 18 years. The thatch materials are treated with a solution of boric acid, copper sulphate, zinc chloride and sodium dichromate. Low-pressure treating equipment has to be erected and a trained technician is needed to supervise the operation of the plant. The cost of the plant in India is Rs 5,000 (A.474). The plant will treat fifty cubic feet of material at each charging. A technician, assisted by two labourers, can complete ten charges in eight hours.

Further copies of the paper fully describing the process and the equipment used are available from the Executive Officer for Social Development, Box 5254, G.P.O., Sydney, Australia.

A simpler method which does not require any special equipment has been found useful in South Africa. There the thatch is merely soaked in a chemical solution before use. The effect is not so long lasting as the Indian method, but the process is much cheaper. Its main purpose is to fire-proof the thatch, but the solution is an insect-repellant as well.

The cheapest chemical used in this process is alum[1], about 4 to 8 ozs. per gallon of water. The thatch is well soaked in this solution and then allowed to dry thoroughly before use.

Various types of alum are available in Australia. The cheapest, Filter Alum (aluminium sulphate), is £A.29 per ton. Potash alum and ammonium alum, which may be a little more effective, cost £A.48 per ton.

Another method consists of making a solution of 1 lb. of mon-ammonium phosphate and about 0.1% of wetting agent to each gallon of water. The dry thatching material is soaked by complete immersion for fifteen to twenty minutes in this solution, allowed to dry and used in the normal way. Mon-ammonium phosphate[2] costs about £A.176 per ton.

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Commission to Meet in October

THE South Pacific Commission will begin its thirteenth session at its headquarters in Noumea, New Caledonia, on 11th October. The Chairman will be Mr. J. R. Halligan, Senior Commissioner for Australia, who is special adviser to the Australian Minister for Territories. Representatives will attend from the six countries who are responsible for the administration of island territories — Australia, France, Netherlands, New Zealand, United Kingdom, United States.

The South Pacific Commission has had 21 specialists in the field this year, in addition to its permanent staff in Noumea and Sydney. They have been working on subjects of regional importance including the improvement of the coconut industry, the problems of subsistence agriculture and village industries, and the development of rice growing. Progress has been made with the publication of literature designed for the islanders, the preparation of teaching aids, and the study of literacy teaching methods. Research has continued into the control of the rhinoceros beetle, population changes, foods and diets, filariasis and malaria.

In these and many other fields, governments and private institutions are being assisted in their efforts to promote the economic and social welfare of the Pacific islander by the regional activities of the South Pacific Commission.

At their meeting Commissioners will have the task of reviewing progress and deciding upon the scope of next year's operations.

Left: Week-old Kenaf (Hibiscus cannabinus) at Laloki, near Port Moresby. Sown with Mitchell disc drill, with 6-inch spacing between drills.
Right: Seed Kenaf, some 11 feet high, at Bubia Experiment Station, Lae.

Soft Fibre Production In The South Pacific

Prospects of developing the natural textile wealth of South Pacific territories are examined in this article . . .

By E. J. E. LEFORT*

THE world market in soft fibres has always been dominated by Bengal (Pakistan), which is virtually the only region in the world with exactly the right environment for jute (*Corchorus capsularis* and *Corchorus olitorius*). This ecological advantage, together with abundant labour which, because of comparatively low living standards, is cheap, accounts for the indisputable influence of the Calcutta market over international transactions in raw materials of this type.

Before the 1914-1918 war Europe was able through the cultivation of hemp (*Cannabis sativa*) to mitigate, to a certain extent, the influence of the Anglo-Indian monopoly in jute on the market for secondary fibres. Unfortunately, since then, rationalization of agriculture and the rise in wages have had disastrous repercussions on this crop which was previously grown by smallholders and now is scarcely found except in Russia, in Italy, to a small extent in Central Europe and sporadically in France, Belgium, and the Netherlands.

At the present time efforts are being made, especially in Germany and France, to replace dioecious hemps (male and female flowers on different plants) whose variability of growth precludes all cultural and technological improvements, by monoecious hemps (male and female flowers on the same plant) which by reason of their uniform ripening and homogeneous product permit of the mechanization of all operations. The stages of fundamental and applied research have now been passed and that of extension is just beginning. However, the production of hemp fibre is still very under-developed, and not for many years to come will it be capable, in the writer's opinion, of providing a regular and adequate source of supply. On the other hand, flax (*Linum usitatissimum*), which is essentially a European crop, prod: an expensive fibre which cannot be put to any of the normal uses fulfilled by the common soft fibres.

Finally, artificial substitutes derived from cellulose, coal or chalk, lacking the qualities required by trade and industry, and being expensive to produce, are not, in the present state of affairs, advantageous substitutes for jute.

This situation exists not only in Europe but also in the other continents which are dependent on the Pakistan sources of jute for the greater part of their requirements in cortical fibres. During the last war this dependence gave rise to a real state of alarm which prompted metropolitan countries to take stock of the textile position in their home territories or in their overseas possessions and, consequently, to consider the introduction of substitutes for jute.

It can definitely be claimed that, under present conditions, with the possible exceptions of Belgium and Russia, no metropolitan country is making the most

* M. Lefort recently joined the Commission as Research Officer, Economic Development. Editor.

of its tropical resources in soft fibres. If one considers that, on the one hand, Pakistan and Indian production of jute supplies 97-99% of world demand, and that, on the other, these countries have a definite tendency to process their fibres locally into manufactured goods, it will be agreed that the outlook for jute-importing countries gives cause for concern.

This new development is illustrated by the new weaving mills of Eastern Bengal which will make it possible for Pakistan in 1954 not only to discontinue importation of jute goods, but even to export 10,000 tons of these goods, thus effecting a saving of about 60,000,000 rupees (£stg.6,650,000). It is perfectly obvious that this is only the beginning of evolution towards national self-sufficiency, and that soon we shall be faced with the fact of a monopoly. Moreover, the risks of poor crops and of possible isolation by war emphasize the dangers of this complete economic dependence and the threat implied to the metropolitan jute industries.

The South Pacific and its two main metropolitan countries do not escape this grip, although New Zealand uses locally a certain amount of *Phormium tenax* in woolpack production. The jute fibre and manufactured jute imports of this vast area amount annually to a sum total of approximately £stg.2,500,000. The territories could break free from this domination by efforts to promote the production of alternative fibres as, indeed, Australia is doing at the present time in Papua and New Guinea. Such local enterprises, at least in their initial stages, could not possibly compete with jute in all the uses to which fibre is put, but if successful they could stem the outflow of foreign currency to some extent and constitute the nucleus of an economic safeguard which could be developed in a period of difficulty.

The best examples of emancipation comes from Belgium, which has managed not only to free itself from the India-Pakistan monopoly by producing *Urena lobata* fibres in the Belgian Congo, but also to compete with jute in the South African market.

In the South Pacific, as elsewhere, there are, growing on roadsides, trails and on waste or cultivated land, plants belonging to great world families which, properly processed, yield valuable fibres at least the equal of those from *Corchorus*.

The table below, which compares the mechanical qualities of various soft fibres with those of jute, serves to illustrate this statement. The plants mentioned in the table are found growing in an uncultivated state in the South Pacific, except jute and kenaf, which have been introduced recently.

Apart from these mechanical qualities, the appearance and pliability of the above-mentioned fibres enable them to replace jute in all its uses, whether in rope-making, sack production, the manufacture of mats, carpets, brushes, etc., or in the production of upholstery plush on a cotton base, linoleum, artificial silk, sail-cloth, and even, combined with linen or china-grass (ramie), in the manufacture of cloth for wearing apparel. It is worth noting that today the use of new softening methods by various chemical processes gives these fibres a far wider range of uses.

The commercial prospects of the fibres considered in this article are determined not only by market questions of supply and demand, but also by questions of agricultural and technological factors and requirements. It is therefore felt that a brief review of several plants with cortical fibres which are either natural or introduced species in the South Pacific area might be valuable.

Urena lobata (*Paka*)

Urena lobata, which belongs to the family Malvaceae, is an erect, shrubby plant, 2 to 5 feet or more high, according to variety and environmental factors. Under cultivation, it is capable of growing to a height of 10 to 13 feet. It is a hardy and adaptable species which has spread over a wide area. It prefers fertile, moist but well-drained soils in open situations. Its cortical fibres have technological qualities at least equal, if not superior, to those of jute.

The cultivation of *Urena lobata* has not so far proved profitable except in the Belgian Congo, where it is grown by the native population[1]. The reasons for this are, on the one hand, problems of labour and cost, to which the only solution is agriculture on a family or tribal basis, and, on the other hand, problems of a cultural and technological nature which can be solved only by means of a series of preliminary field trials conducted scientifically. At present, as a result of world research on exotic textiles, answers have been found for these problems, and the results obtained suggest that practical application of the techniques developed might follow quickly.

It has been shown that the cultivation of *Urena lobata* can be completely mechanized; that its yield can be as high as, and even greater than, 2,700 lbs. of fibre to the acre, for stem heights varying between 10 to 13 feet; and, in short, that the different technological treatments by chemical, bacteriological and mechanical means can now be generally introduced.

If, to these positive results of investigation, is added the fact that *Urena lobata* can produce a second crop in the year from ratooning, it will be agreed that this plant is of real economic interest for the South Pacific.

Hibiscus cannabinus (*Kenaf*)

Hibiscus cannabinus, commonly called Kenaf, is one of the Malvacaeae with upright stems, and wide geographic distribution. Its stem measuring from 6 to 10 feet, produces a fibre that is less likely to rot, and more tough and glossy than that of jute; it can, despite its lack of pliability, take an important place amongst the soft fibres.

The value of *Hibiscus cannabinus* was made especially apparent during the last war, and since then field trials have been carried out almost everywhere in the tropical regions. However, in Russia and Manchuria this fibre crop has been grown for a long time.

Like *Urena lobata*, the yield of Kenaf in dried fibres is as much and even more than 2,700 lbs. to the acre for stem heights from 10 to 13 feet.

Fibre extraction techniques have been improved and cultivation is now completely mechanized. In fact, cutting can be done by combined reaper-binder with mechanical stripping on the spot, or by the pick-up reaper which cuts the stalks, flattens them and packs them in bales ready for transport to a processing centre. Here only flattening, stripping, softening and carding need be carried out, giving fibres which, although not freed from resins, are perfectly usable for coarse weaving. This marks progress of exceptional importance for the future of the soft fibre industry which has always had to contend, especially where

[1] The system of shifting cultivation practised by the Belgian Congo population is very similar to that found in the South Pacific.

COMPARISON OF VARIOUS SOFT FIBRES WITH JUTE

Mechanical qualities	*Corchorus capsularis* (Jute)	*Urena lobata* (Paka)	*Triumfetta cordifolia*	*Sida rhombifolia*[1]	*Hibiscus cannabinus* (Kenaf)
Breaking Length (Km.)	30-38	35-40	20-25	40-45	35
Resistance to the mm^2	24.3	32.5	20.1	41	—
Fineness in metric No.	250-300	200-250	125-175	250-300	100-300
Index to rigidity	1.5-1.7	1.6-1.8	—	1.9	1.7-1.9

[1] **Sida rhombifolia** possesses mechanical qualities superior to those of jute.

the crop is grown by native farmers, with the limitations resulting from its special technological requirements.

Valuable by-products can be extracted from *Hibiscus cannabinus*. The central cylinder, left after threshing, and the remnants from combing contain respectively 38% and 70% of fairly pure cellulose, and make excellent paper pulp which when rolled out gives an extremely white and slightly glossy sheet of paper with all the qualities required to satisfy public demand. Obviously, old sacks, discarded ropes, etc., . . . come into the category of waste matter richest in cellulose. These special potentialities tend to prove that under regular cultivation, *Hibiscus cannabinus* is suitable not only for supplying a first-rate textile industry, but also as a worthwhile source of raw material for paper-making.

If harvested fairly late, at the beginning of fruit formation for instance, Kenaf produces, per ton of dried fibres, 1,500 to 2,200 lb. of seed containing 17% to 20% oil which can be used both for feeding purposes and soap making. The residual cake with its high nitrogen content, can serve as cattle food or be used as a soil fertilizer.

The adaptability of *Hibiscus cannabinus* and its undoubted economic potentiality make it worthy of thorough investigation from the agricultural point of view, in the particular environments of the South Pacific territories. Papua and New Guinea began such investigations some years ago.

Hibiscus sabdariffa (*Roselle*)

Hibiscus sabdariffa, one of the Malvaceae known as Roselle, is a shrub from 3 to 13 feet high which is essentially tropical and equatorial and demands a great deal of water and heat for growth. Its life cycle is longer than that of Kenaf and its fibre yield is almost identical. This fibre, although slightly less pliable than that of jute, is well suited, by reason of its toughness, rot-proof quality, gloss and colouring, for all uses in sack-making, rope-making, mat and brushware manufacture, etc.

Roselle and Kenaf need not, in the writer's opinion, enter into competition in any given region, but can, on the contrary, complement one another. In fact, these two plants which produce almost identical fibres require very different environments, a fact which must be borne in mind in any consideration of them. If these ecological factors are respected, their development is very satisfactory, and they are capable, in conjunction, of producing a very high yield of soft fibres.

The cultivation of *Hibiscus sabdariffa* in Java became profitable only under social and economic conditions comparable with those in India. Such conditions occur only occasionally in the South Pacific where it would be necessary to adopt modern methods of production.

1—Branch of Triumfetta cordifolia; 1a, fruit cluster. 2—Hibiscus tiliaceus; 2a, seeds; 2b, fruit.

At the present time, progress made in this field affords excellent prospects for Roselle, which is considered one of the best substitutes for jute.

Sida rhombifolia

Sida rhombifolia also belongs to the family Malvaceae. It is an annual plant with a fairly heavy branch system, its height varying between 5 to 6 feet. For cultivation, its requirements are definitely not as great as those of the Malvaceae previously discussed. Although growing better in fertile, light and deep soils, it can do quite well, because of its well-developed root system, in land generally considered poor, provided, however, that it is not too wet. It is worth noting that it prefers excessive sun to excessive rain.

No systematic research has yet been done on *Sida rhombifolia;* however, several mass experiments in cultivation have produced yields varying between 1,000 and 1,400 lb. of fibre to the acre. A preliminary selection with a view to isolating the tallest and those with fewest branches would certainly have a most favourable influence on the fibre production possibilities of this plant.

Analyses of the fibre from *Sida rhombifolia* give good results and place it on the same level as first quality jute, and sometimes quite definitely above with the added advantage that it has greater durability and flexibility.

This textile plant, by reason of its ability to adapt itself to less fertile ground and the high quality of its product, deserves to become the subject of field trials in suitable regions of the South Pacific.

Ramie

Ramie fibre is the product of *Boehmeria nivea* and *Boehmeria utilis* belonging to the family of Urticaceae. These two species represent respectively White China-grass and Green China-grass whose original environments are quite dissimilar. The former is best suited to temperate climates, either warm or subtropical, whilst the second prefers tropical and equatorial climates; from both these points of view the two species are of interest in our area.

China-grass is a demanding crop as far as soils, fertilizers, and humidity are concerned. It could be an economic proposition wherever the commercial cultivation of the banana is successful, but only on ground which can be worked mechanically. Fibre yield is high only when it benefits from manures and fertilizers.

China-grass, whose stem height exceeds 6 feet under normal conditions of cultivation, gives a fibre of incomparable quality which certainly deserves to be used for purposes superior to those for which the common soft fibres are intended. It is commonly used for clothing, furnishings and high quality paper-making and numerous other purposes in industry and medicine.

The techniques of growing and processing China-grass have now been brought to a sufficient degree of perfection to permit a profitable production of first-class fibres. New processes in cutting, defibring, chemical washing and bacteriological treatment promise a great future for the Boehmeria group. Moreover, the world market in textiles is ready

to offer China-grass the place it deserves, provided, however, that it remains in continuous supply.

A further point is that the leaves and tops of the Boehmeria group are even richer in nutritive elements than lucerne and are commonly used for cattle feed in cake form.

From the above, it is clear that the cultivation of China-grass is possible only on the level of European exploitation. Indeed, to be at all profitable, plantations should be on an industrial basis, with processing centres each handling the yield from at least 500 acres.

It is considered that preliminary experiments might be conducted on this plant in New Guinea, as in various parts of Africa. If results were favourable, such trials would provide a technical basis for the development of organized cultivation of China-grass.

Other Fibre Plants

The textile flora of the South Pacific territories provides, with certain of its families such as Malvaceae, Tiliaceae, Sterculiaceae, Grasses and even Euphorbiaceae, a wide field for investigation. I believe that the possibilities deserve a systematic and thorough study.

Problems of Soft Fibre Production in the Pacific

The problems associated with the production of soft fibres in the South Pacific, and technical, social and economic implications, may now be examined.

The balance of the economy of any raw material is based primarily on the permanence of its markets, secondly on that of its source of production and finally on its cost of production. These three determining factors, as well as their component elements, must be analyzed by competent technicians who, through findings as realistic as possible, pave the way for a rational plan for the establishment and development of the new activity in view.

In an integrated programme for the development of textile cultivation, overseas for instance, it is desirable that the finance be provided either by large private organizations or by state institutions. The means to ensure this financial backing may be very varied. An agency setting up a fund for the promotion of textile production in overseas territories, derived from light taxes on the processing industries, would provide all the financial and moral assurances required to guide the destinies of the new enterprise. The methods of this promotion system might also be very diverse, but it seems that the most efficient would be to impose special taxes, allowing each industry to encourage the production of the raw material with which it deals. In this way subsidies provided by the jute industry could be directed wholly into research on the cultivation and technology of soft fibre plants.

Such a system, at the cost of placing a slight burden upon the textile industries, would endow research organizations with sufficient means to undertake the series of experimental tests which are essential before launching a new type of cultivation. I wish to place particular emphasis on this latter point; its neglect always causes great loss to aspiring tropical producers, often more gifted with good intentions than with technical knowledge.

Not only capital is needed for starting or improving production; authoritative advice is even more important. It is the need for provision of the latter that prompts me to favour the establishment of a promotion agency which, whatever form it may take, is the only way to ensure the sound development of a whole new enterprise.

The few plants briefly described here do not raise any serious agricultural problem (with the exception of ramie), for all, it is emphasized, are found as weeds growing along roadsides, or in association with or after crops, or else have been naturalized in the territories. All are capable of giving, in their natural area of distribution, the levels of production required both by European colonizers and native farmers.

The technological problem is quite a different matter: the local standards of processing, which are rarely very advanced, come up against the demands of the market, which the producers have difficulty in understanding but with which they have to come to terms. Indeed, tropical fibres have, from the start of their development, always to fight hard to attain the level of products of the same type already established on the world markets. This level is all the harder to reach since the various processing techniques of fibres are assimilated only with difficulty by indigenous peoples; moreover, the consumer industries eliminate systematically all raw materials not possessing certain clearly defined qualities. This economic obstacle is not insurmountable, however; it can be overcome by the technological education of native and even European sections of the population. After training, they can turn out a product up to the defined standards for fibres of fair and marketable quality.

Within the framework of such an educational project might be grouped the study of the prospects in weaving for handcraft workers and the small industries of the islands, with the practical aim of introducing pre-adapted machinery, demonstrating its functions and the use of its products. In Japan, America and even Europe, there exist simple spinning and weaving machines with which handworkers can produce string, mats, matting, door-mats, and fabrics of greater or lesser coarseness. Similarly, it would not be out of the question to suppose that a sack-making industry might be established where soft fibres are produced, using machinery originally designed for jute materials.

This idea of evaluating and utilising the textile resources in the territories implies the possibility of new industry which, directed along the right lines, could not fail to have favourable effects on the economic standards of the region.

In the demographic evolution of the South Pacific there are two divergent tendencies which divide the region into two zones; one over-populated, the other under-populated. Consequently, the development of such a region necessitates almost opposite methods depending on environmental conditions. Fibre production is sufficiently adaptable to meet the demographic requirements of the different territories with which we are concerned. Indeed, the cultivation of jute and its substitutes can be conducted either on a family basis as in India, the Belgian Congo, and Java, or else on an industrial capitalistic scale as in Cuba or French Equatorial Africa.

One of the favourable aspects of soft-fibre production is that the commercial handling of its output would help forge a close and friendly economic link between European and native producers. In other words, the latter could sell the former their crops in the form of decorticated, defibred or retted produce, or else ready spun for weaving. This type of co-operation would help not only to fulfil the aspirations of the local islanders who are increasingly anxious to take an integral part in all branches of present-day activity but also to give them an efficient technical training, the value of which is unquestionable.

Mr. V. D. Stace, who has dealt with this question of economic education extremely well in his report on *The Pacific Islander and Modern Commerce* (SPC Technical Paper No. 54), sees, moreover, in co-operative societies an economic and social organization well adapted to the native populations of the region, which do not necessarily regard individualism as a desirable basis of development. I, too, consider that the collective society is the only one capable of grouping together and controlling freely the productive forces of the islands. It would therefore seem advisable to deal with the produce of fibre plants by co-operative methods wherever soil, climatic and social factors allow.

Conclusion

The problem of textiles of cortical origin seen as a whole presents two quite typical and complementary aspects; on the one hand, the urgent need of a manufacturing industry seeking to escape from direct economic dependence which grows daily more apparent; and, on the other, the perfectly legitimate commercial aspirations of certain overseas territories which find that their products are cap-

able of satisfying, at least in part, the intake of the metropolitan markets.

We have seen that the conditions favourable for launching production are not lacking in the area, and that the chief obstacles encountered in specialized processing can now be avoided by the use of new and tested techniques. With this in view, the development of the natural textile wealth of the islands would appear to be an important step forward, as much on the moral plane as in the economic field.

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Drainage Reclamation in Fiji

MR. P. McNee, Director of Irrigation and Drainage, Malaya, who visited Fiji last February at the request of the Colonial Office to advise the British Government whether reclamation of Fiji's swamp areas merited support from the special Rice Investigation Fund, has reported that he considers that the potentialities of the Toga, Navua and probably some smaller areas, justify full investigations being made. His recommendations are now being studied to decide whether or not an application should be made for funds.

Mr. McNee points out that although purely engineering considerations are not likely to cause any difficulty, the effective utilization of reclaimed areas and the recovery of the costs of development from owners of the land will involve agricultural and administrative issues which should be clearly defined before the projects are started.

A provisional estimate of the probable cost of a drainage survey of approximately 35,000 acres is £66,000 sterling. No estimate of the probable costs of drainage works which would follow the survey can be obtained at this stage.

Credit Unions in Fiji

IN Fiji, considerable progress is being made with the formation of credit unions. The moving spirit in this work is the Rev. Father Ganey, and it is hoped that a later issue of the *Bulletin* will carry an article by him outlining the nature of credit unions and describing their development in Fiji.

Following are extracts from a report published in *News from Fiji* dated 29th July, 1954:

> Ratu Sir Lala Sukuna and a small group of people associated with the Credit Union movement in Fiji paid a visit on July 25th to Kalokolevu, a village some twelve miles from Suva on the Queen's Road. The first Credit Union in Fiji was formed at Kalokolevu and the visitors were most impressed as they watched a meeting of the Union being held.
>
> The formal business was conducted by the Union officers with confidence and efficiency and the visitors then watched members making their deposits, repaying instalments on loans and checking their pass-books. There was a general air of enthusiasm and pride in the new organization. Outside the bure (Fijian house) where the meeting was held, some of the things bought by members who borrowed from their Credit Union were displayed. They included two punts, a fishing net, a pair of bullocks, a number of pressure lanterns and a bicycle.
>
> One of the most enthusiastic members of the Union is Joe Kurusiga. He is a fisherman, but until recently he made very little profit as half of the proceeds of his catch went in the hire of a punt. With the help of the Credit Union he now owns his own punt, which he has named with pride, *Kalokolevu Credit Union*
>
> Credit Unions aim at training their members in the use and control of money and they encourage regular saving. They make loans to members in time of need or to enable them to finance purchases. The affairs of each Union are controlled by an elected committee, and applications for loans are considered by elected officials of the Union. An Ordinance to regulate Credit Unions in the Colony was passed at the last session of Legislative Council. . . .
>
> . . . An advisory council to guide the development of the Credit Unions movement has been set up in Suva, where a shop and general headquarters have been established.

As at 1st September, 1954, there were 32 registered credit unions in Fiji, with a membership of 4,000. Over 100 applications for instructions and assistance in organizing new ones were on hand. Subscriptions since the first credit union was established on 8th January, 1954, totalled £10,000, while loans granted numbered 1,000 and amounted to £12,000.

Of the 32 credit unions already operating, 18 are Fijian village unions and 14 are industrial and Suva City unions. In Suva, where it has been found that usury is rife, the loans are largely provident, but in the villages they tend to be more productive.

Animal Quarantine at Kila

Continued from page 23

animals were used for the last test to be carried out upon the Zebu cattle imported from Pakistan. The method of the test is as follows.

Blood is first taken from each of the Zebu. The blood is then injected into the

Double barbed-wire fence around the Kila animal quarantine station.

calves. Then within a certain time, if the calves develop a high temperature or fever, it means that the Zebu from which the blood came, is still a carrier of certain blood diseases. Probably it would then have to remain in quarantine for a longer period. If, on the other hand, no effect is produced on the calf, the Zebu is clear and can be allowed permanently into the country.

Once this final test has been carried out, all the Zebu cattle which pass the test are to be sent to the Papuan Lowlands Livestock Station outside Port Moresby to breed with Australian types of cattle (but see appended note). From the results of these unions it is hoped that a reliable type of cattle will be produced for service in the Territory.

First remember the fact that it cost thousands of pounds just to bring these cattle to the Territory. To this must be added the cost of feed for a year, the cost of building this expensive station at Kila and the cost of staff to run it over that time. This will give some small idea of what a big job this is. The Department of Agriculture and the Commonwealth Scientific and Industrial Organization have to run this station in order to bring good cattle to the Territory. It is hoped that one day there will be sufficient cattle in the Territory to meet the needs of everybody.

QUARTERLY READING LIST No. 12

A bibliography of publications relating to social development in the South Pacific.

THIS Reading List represents an attempt to note every item to appear in the field of social development in the South Pacific during the past quarter. The entries are drawn from over 100 periodicals which are regularly examined, as well as from bibliographies, publishers' notices and similar material. While it is clearly impossible to check for errors which may occur in the latter type of material (for example, in the classification used in the original sources or in the entries themselves), it is felt that this danger is outweighed by the relatively complete coverage given by this method of compilation. Publications of the South Pacific Commission have not been indexed. Items in the list marked with an asterisk have not been seen in the Social Development section.

The Executive Officer for Social Development, G.P.O., Box 5254, Sydney, will be glad to obtain for any metropolitan or territorial Government copies of items listed, even though the original material may not be available in Sydney.

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LATHAM, R. T. E. The New Hebrides Condominium. Melbourne (1927?), 70 pp. Typescript. It is understood that the manuscript is of a thesis presented at Melbourne University.

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A chacun sa maison: construire ou fais construire. Published by the Bureau de l'Information pour Indigènes. Service des A.I.M.O. du Gouvernement Général-Kalina. 103 pp., illus., plans. Includes chapters on adobe brick construction, with illustrations of the equipment to be used, how to build houses of more durable materials with instructions for the owner-builder, etc. It is profusely illustrated with line drawings and photographs.

No. 158

Report on Education in Western Samoa, by C. E. Beeby. Wellington, Govt. Printer, 1954. 40 pp. A report by the Director of Education in New Zealand on the changes that had taken place since he had last visited Western Samoa in 1945 with recommendations on the further development of the school system in the territory.

No. 159

Planned development in the less developed countries. Reprinted from *Planning,* vol. 19, no. 351. February 16, 1953, pp. 153-157, which is published by PEP (Political and Economic Planning). The publication suggests that it is possible to draw up a set of "working rules" useful to all who are concerned with development in less-developed territories.

No. 160

Pamphlet for Potters. Published by the United Nations and Prisco, Manila. 27 pp., illus., *mimeographed.* A very simple, well-illustrated booklet describing the elements of pottery work and the basic tools used in the craft.

No. 161

Social welfare work in Jamaica, by Roger Marier. Paris, Unesco, 1953. 166 pp., bibl. (Monographs on Fundamental Education VII.) A study of the Jamaica Social Welfare Commission by a member of the staff of the Department of Social Work, McGill University, Toronto.

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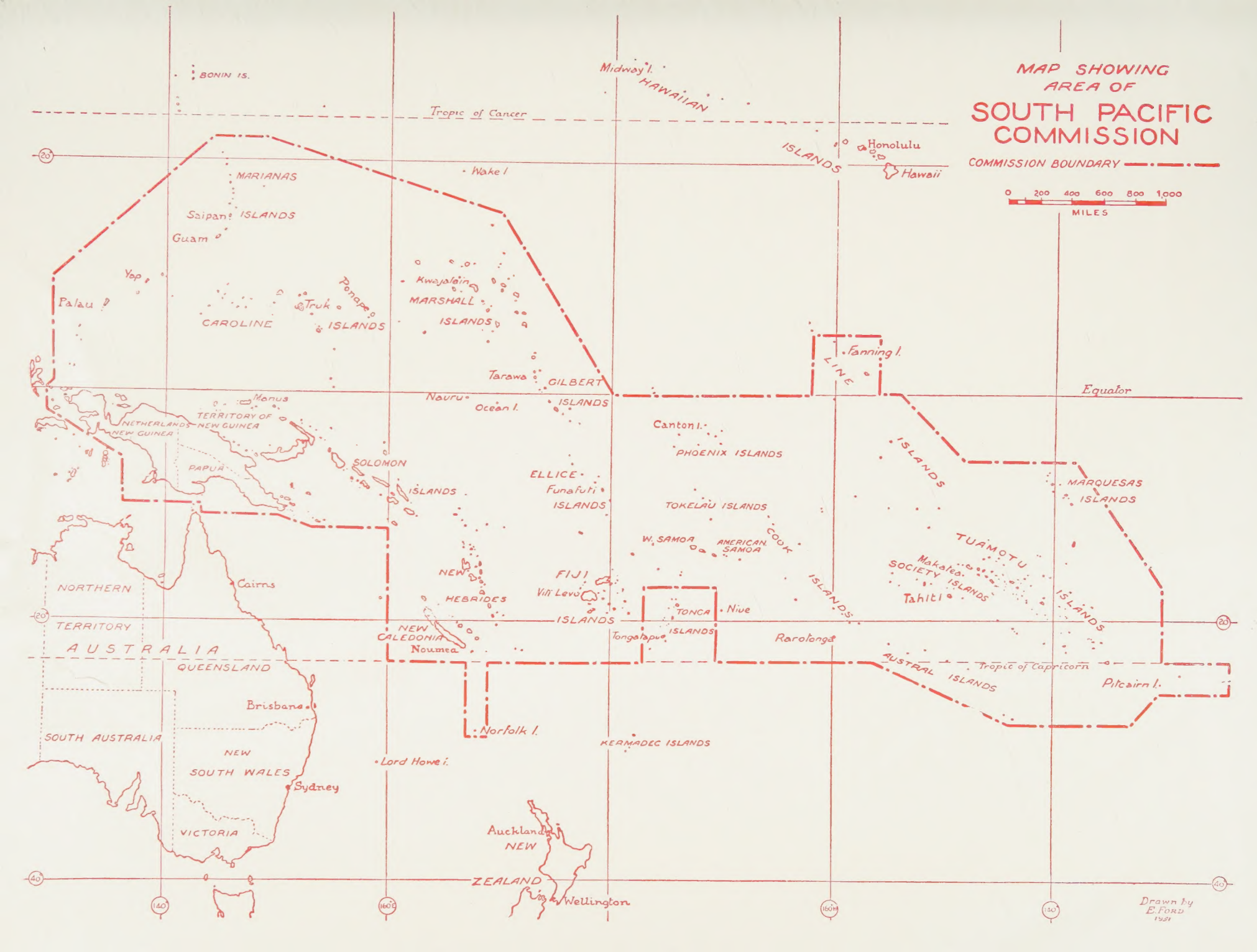
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